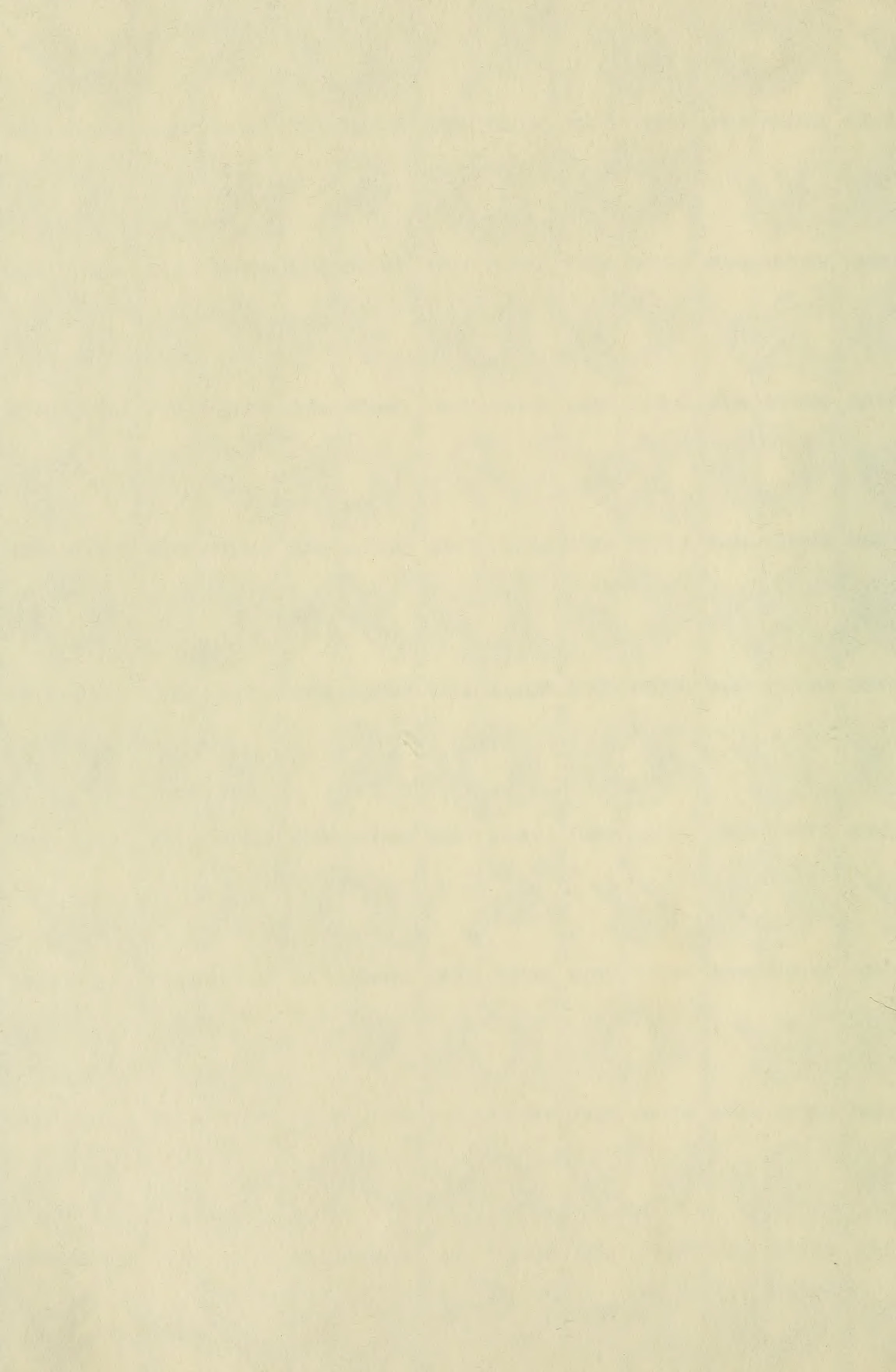



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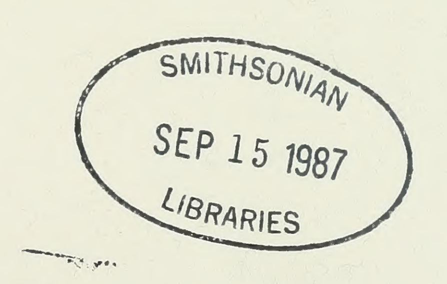


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Herpetofauna Caboverdiana

Von Hans Hermann Schleich



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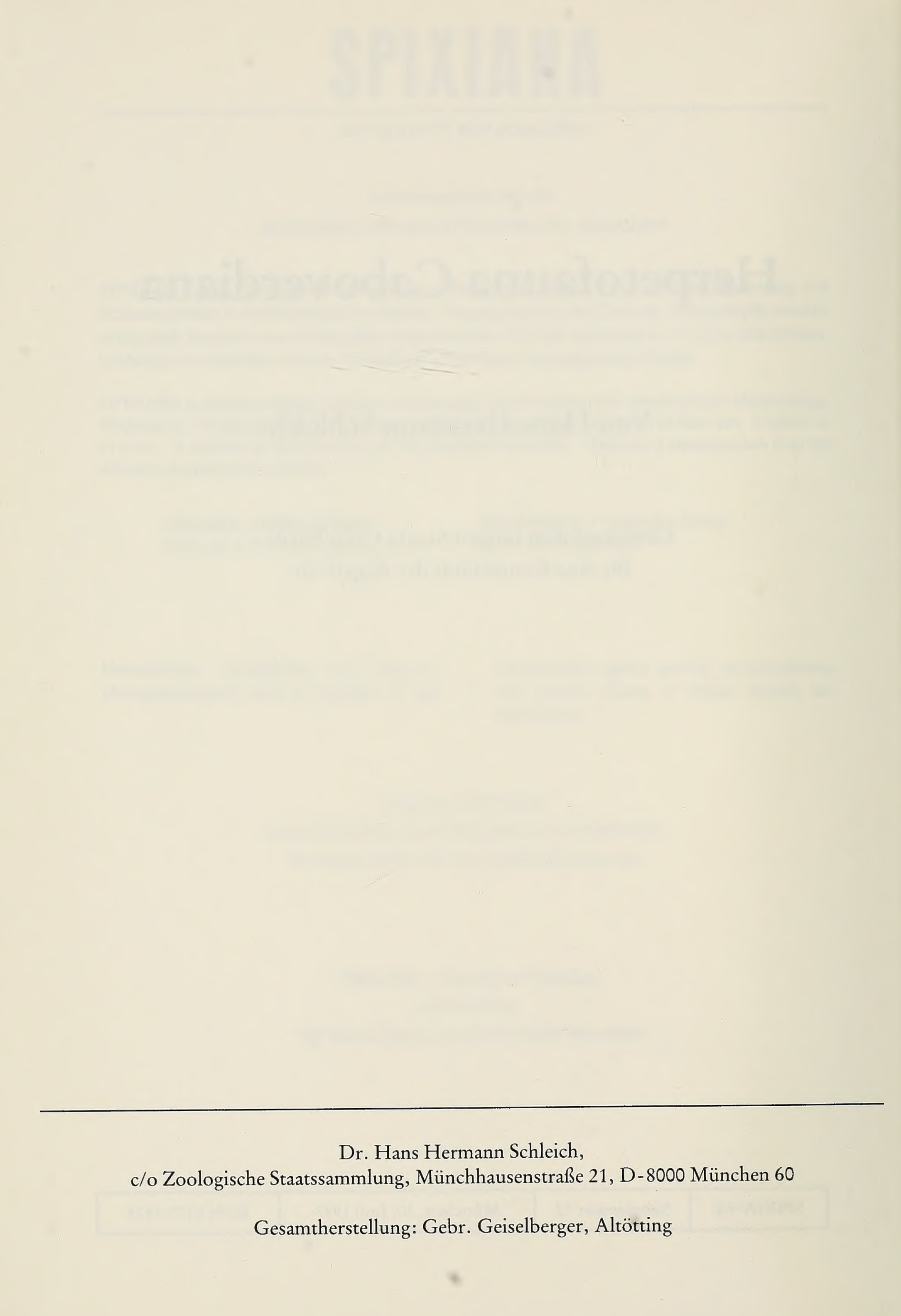
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Herpetofauna Caboverdiana

Von Hans Hermann Schleich

Gewidmet dem jungen Staate Cabo Verde –
für eine Kontinuität der Regenzeit

SPIXIANA	Supplement 12	München, 30. Juni 1987	ISSN 0177-7424



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Herpetofauna Caboverdiana

Von Hans Hermann Schleich

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Abkürzungen für Sammlungen und Museen:

ZSM	Zoologische Staatssammlung München
BMNH	British Museum (Natural History) London
ZFMK	Zoologisches Forschungsinstitut und Museum A. Koenig Bonn
MCNG	Museo Civico di Storia Naturale Genova

Vorwort

Eine ungezählte Namensliste kapverdischer Bürger, seien es Bauern, Fischer oder Kinder, die mit Rat und Tat, mit Fanghilfe und Hinweisen meine Arbeiten unterstützten, aber auch viele entgegenkommende Entwicklungshelfer, die sich um mein und meiner Begleiter Wohlergehen kümmerten, wären hier anzufügen. Allen sei hier aufrichtigst gedankt.

Einen wohl kaum in Dankesworte ausdrückbaren Beitrag zum Gelingen des Projektes leisteten meine Reisebegleiter D. BENDER (Basel), H.-J. GRUBER (Schliersee) und M. WUTTKE (Frankfurt).

Mein allerherzlichster Dank für ihr persönliches Engagement und zuweilen auch tatkräftige Unterstützung bei Recherchen, aber auch im Gelände, gilt besonders E. STEIN, weiter I. FARIA, M. DUARTE-ALMEIDA, H. SOARES, A. PIRES, X. BARBOZA, M. ALMEIDA (alle genannten Cabo Verde) sowie H. & K. ZILLER.

Dr. U. GRUBER und Dr. W. KÄSTLE korrigierten freundlicherweise das Manuskript und trugen durch ihre freundschaftlich kollegiale Kooperationsbereitschaft sehr zum Gelingen dieser Arbeit bei.

Für die Exkrement-Rückstandsuntersuchung zur Analyse der Nahrungszusammensetzung bin ich Dr. E.-G. BURMEISTER zu verbindlichstem Dank verpflichtet.

Leihmaterial stand mir dankenswerterweise aus den Museen Wien, Turin und London zur Verfügung. Eine Ausleihe des MERTENS'schen Materials aus dem Senckenberg-Museum Frankfurt war leider auch nach mehrmaligen Versuchen über Jahre hinweg nicht möglich. Der Deutsche Akademische Austauschdienst (DAAD) förderte durch seine Finanzierungshilfe der zweiten Reise im Frühjahr 1981 den Fortgang der Arbeit.

Besonderer Dank gebührt auch Dr. W. LOBIN (Frankfurt) für die Zusammenarbeit und Korrektur dieser und vorhergehender Kapverdenarbeiten.

Sowohl einige Exemplare der beiden Riesengeckoarten der Inseln Branco und Razo als auch *Mabuya vaillanti* von S. Thiago befinden sich zu Beobachtungs- und Nachzuchtzwecken in Terrarienhaltung bei Herrn H.-J. GRUBER und mir. Betreffs letztgenannter Art *Mabuya vaillanti* danke ich herzlichst Herrn R. STEFFENS für die Fundorthinweise, aber auch für das Überlassen von drei Zuchttieren.

Aus Prioritätsgründen mußte leider ein Teil zur Systematik der Geckos (Gattung *Tarentola)* vorab (SCHLEICH 1984) publiziert werden.

Zusammenfassung

Die Herpetofauna der Kapverdischen Inseln wird beschrieben und revidiert. Die der Beschreibung zugrunde liegenden Informationen stammen aus der bisher bekannten Literatur sowie aus dem in den Jahren 1977–1981 neu aufgesammelten Material.

Sieben Formen werden neu beschrieben (incl. SCHLEICH 1984), zwei revalidisiert sowie zwei aus dem Unterart- in den Art-Status erhoben. Aufgrund der Ausbeute von Fischern, der auf den Märkten angebotenen Ware und den Informationen durch die SCAPA-Dienststellen waren Angaben über das Vorkommen von Seeschildkröten möglich.

Neben den systematisch-taxonomischen Beschreibungen werden Angaben über die einzelnen Inseln sowie zur Ökologie und Biologie ihrer Herpetofaunen, basierend auf Geländenotizen, Terrarienhaltung, Zuchterfolgen und Kotuntersuchungen gegeben. Ein dem Autor dringend notwendig erscheinender Arten- bzw. Biotopschutz wird diskutiert.

Summary

The herpetofauna of the Cape Verde Islands is described and partially revised. The paper is based on the literature and own collections and descriptions of the material collected in the years 1977–1981. Several new forms are described or their taxonomic status is discussed.

Informations about the seaturtles are due to the public merchandise or informations from SCAPA. Beside the systematic and taxonomic work informations about the islands, their biological-herpetological facts based on fieldnotes or terraristic observations are given. The necessity of a general protection of species and habitats is discussed.

Résumé

L'herpetofaune des Iles du Cap Vert est déscrite et revisée (en partie). Les informations qui font la base de cette description, sont tirées de la littérature déjà existante à ce sujet, ainsi que du materiel nouvellement collectionné dans les années 1977–1981. Il s'agit d'une nouvelle description pour sept formes (incl. SCHLEICH 1984), ainsi que d'une discussion de leur statut taxonomique.

Les informations sur les tortues de mer sont dues à la marchandise publique et aux renseignements de la SCAPA. En plus des descriptions systématiques et taxonomiques, ce rapport contient des informations sur les différentes îsles, concernant l'écologie et la biologie de leur composition herpetofaunistique, basées sur des notes sur le terrain, des observations en captivité, des succès d'élevage et des analyses des excréments.

L'auteur y ajoute une discussion sur la nécessité absolue d'une protection des espèces et des habitats.

Resumo

A herpetofauna das Ilhas de Cabo Verde é descrita e revisada. As descrições baseam-se na literatura e no material das colecções novas dos anos 1977–1981.

Sete formas são descritas de novo (incl. SCHLEICH 1984), duas são reválidadas e duas subespécies são elevadas ao nivel de espécies.

O estudo da pesca e dos mercados de peixe assim como as informações da SCAPA facilitaram indicações da presença das tartarugas do mar. Junto das descrições sistemáticas e taxonómicas esta publicação contem informações da cada Ilha por si e da ecologia e biologia da herpetofauna. Estas indicações baseam-se nas noticias do terreno, nas estudos do terrario, nas criações e nos análises dos excrementos.

O autor discute a necessidade e a maneira prática duma protecção das espécies e dos biotopos.

1. Einleitung

Die Untersuchungen und Bearbeitungen der Kriechtiere der Kapverden wurden durch die erneute Aufnahme von Nachforschungen zur Überlebensfrage von *Macroscincus coctei* (s. SCHLEICH 1979a und 1982b) eingeleitet. Eine erste Sammelreise im Sommer 1979 führte dabei auf die Inseln Boa Vista, Sao Thiago, Fogo, Branco, Brava und S. Nicolau. Während eines Aufenthaltes auf den Inseln Branco und Razo, dem einstigen Lebensraum von *Macroscincus coctei,* konnten leider keinerlei Spuren und Anzeichen für ein Überleben des kapverdischen Riesenskinks gefunden werden. Zwei weitere Reisen im Frühjahr und Spätsommer 1981, mit jeweils mehrwöchigen Aufenthalten auf den Inseln Santa Luzia, Branco und Razo, erbrachten ebenfalls nur negative Ergebnisse bezüglich der Nachforschungen zur Überlebenschance dieser Großechse. Der Hinweis von Einheimischen über das Vorkommen eines großen Skinkes (kreol.: ,,Chinel"; s. SCHLEICH 1982) auf Fogo und Sao Thiago lenkte erneut die Aufmerksamkeit des Autors auf die Suche nach *Macroscincus coctei.* Nach Abschluß der letzten Sammelreise im September/Oktober 1981 konnten nun von allen Inseln (außer den unbewohnten Felsinselchen der Rhombosgruppe) Reptilien und Amphibien aufgesammelt werden, so daß vorliegende Zusammenfassung ermöglicht wurde.

Die Widersprüche der einzelnen Bearbeiter zur Herpetofauna der Kapverden kamen in der Tabelle über die Verbreitung der Reptilien auf den Kapverden (SCHLEICH 1982: 246) deutlich zur Geltung.

Nicht nur aus diesen Unklarheiten bisheriger Bearbeitungen, sondern auch im Rahmen eines internationalen Gesamtforschungsprojektes ,,Makaronesische Inseln", war nun endlich die Neubearbeitung der kapverdischen Herpetofauna erwünscht. Bewußt wurde dabei versucht, alle Inseln selbst zu bereisen, um über die wirkliche Herkunft der Aufsammlungen Klarheit zu haben. So basiert auch, bis auf wenige Ausnahmen, der Hauptteil dieser Arbeit auf eigenen Aufsammlungen.

Historischer Überblick

Mit der Erstbeschreibung von *Macroscincus coctei* als *Euprepes Coctei* lieferten DUMERIL & BIBRON (1839) den ersten herpetologischen Beitrag über die Kapverden. Weitere Grundlagen zur Kenntnis der Kapverden-Reptilien sind durch BOCAGE (1896), ANGEL (1935, 1937) und MERTENS (1955) geschaffen worden. BANNERMAN & BANNERMAN (1968) geben einen zusammenfassenden Überblick über die Herpetofaunenverteilung auf Gesamt-Makaronesien wieder. GREER (1976) berichtete in einer ersten Detailstudie ausführlich über *Macroscincus coctei,* worauf SCHLEICH (1979, 1980, 1982) sowie GRUBER & SCHLEICH (1982) mit weiteren Nachforschungen und Bearbeitungen zu den Riesenechsen der Inseln Branco und Razo als letzte Bearbeiter folgten. Weitere systematische Beschreibungen lieferten GRUBER & SCHLEICH (1982) und SCHLEICH (1984).

2. Allgemeiner Teil

2.1 Die Kapverdischen Inseln in Makaronesien

Nachdem in letzter Zeit von verschiedensten Autoren verstärkt Augenmerk auf die wissenschaftliche Bearbeitung der Kanaren gelegt wurde, stehen nun die Azoren, Madeira, Selvagens und die Kapverden in vergleichender Betrachtung zu ihrer Faunen- und Florenentwicklung. Während das Problem

von Migrationen und Besiedlung dieser atlantischen Inselgruppen zum Hauptdiskussionspunkt wurde, drängt sich natürlich die Frage nach bestandenen Festlandsverbindungen, aber auch jene der inter- und intrainsularen Zusammenhänge auf. Besteht auf den Azoren die Kriechtierbesiedlung aus nur einer Form *(Lacerta dugesi)*, so weist das südlichere, festlandsnähere Madeira bereits ein Faunenspektrum von acht Arten auf. Auf den Kanaren steigt die Artenfülle bereits auf 19 Arten an, die sich letztlich bei den Kapverden auf nun 23 Formen beläuft.

Bemerkenswert ist ebenfalls das Verhältnis von ,,Kriechtier-Endemiten" auf den jeweiligen Inselgruppen. Sie stehen im Verhältnis (nach BANNERMAN & BANNERMAN, 1968, BISCHOFF, 1985 und vorliegender Bearbeitung)



Azoren (0) : Madeira (4) : Kanaren (11) : Kapverden (21),
woraus sich für die Kapverden der höchste Endemitenanteil ergibt.

Zu berücksichtigen sind bei solchen Zahlen jedoch noch vielerlei Umstände bei der Diskussion um die Speziationen, wie beispielsweise Landbrücken, Klima, Driftmöglichkeiten, Entfernung u. a. m.

2.2 Bemerkungen zur Geographie, Geologie und Klimatologie

Die Kapverden, seit 1975 unabhängiger, selbständiger Inselstaat, bestehend aus 10 größeren und 8 nennenswerten kleineren Inseln, liegen ca. 400–600 km westlich vor Senegal zwischen 14°48′ und 17°12′30′′ nördlicher Breite und zwischen 22°44′ und 25°22′ westlicher Länge zwischen dem Wendekreis des Krebses und dem Äquator. Orographisch betrachtet lassen sich die Inseln in flache, wüstenhafte Inseln (Sal, Boa Vista, Maio, São Vicente, Ilhas do Rhombo, Branco, Razo und Santa Luzia) sowie in die vegetationsreicheren gebirgigeren Inseln São Thiago, Brava, Fogo, St. Antão und S. Nicolau gliedern.

In nachstehender Tabelle sind die höchsten Erhebungen (H, in m) der Inseln sowie ihre ungefähre Flächenerstreckung (F, in qkm) in „ca."-Werten angegeben.

	Sal	Boa Vista	Maio	S. Vicente	Rhombos	Branco	Razo
H	406	390	436	774	96	327	164
F	200	620	250	220		3	7

	St. Luzia	S. Thiago	Fogo	Brava	St. Antão	S. Nicolau
H	395	1392	2829	976	1979	1304
F	16	1000	500	65	730	350

Ein allgemeiner Abriß zum Vegetationsbild der Inseln wurde von Lobin und Groh (1979, 1980) und von Schleich & Wuttke (1983) für die kleinen Eilande St. Luzia, Branco und Razo gegeben. Die geologischen Fakten zur Entstehung des Archipels bzw. der einzelnen Inseln sind noch relativ undurchsichtig. Verallgemeinert kann gesagt werden, daß der gesamte Archipel atlantischen Ursprungs ist. Die vulkanische Entstehung der Inseln im Tertiär, wahrscheinlich Miozän, kann angenommen werden; eine Festlandsverbindung zum afrikanischen Kontinent, auch in jüngeren geologischen Epochen, erscheint aber aufgrund der bis zu 3000 m tiefen Beckenregionen zwischen dem Archipel und dem Festland nie bestanden zu haben. Daß viele Inseln noch bis in die Quartärzeit (Fogo bis rezent) vulkanisch aktiv waren, ist durch die unverwitterten vulkanischen Formationen zu erwarten.

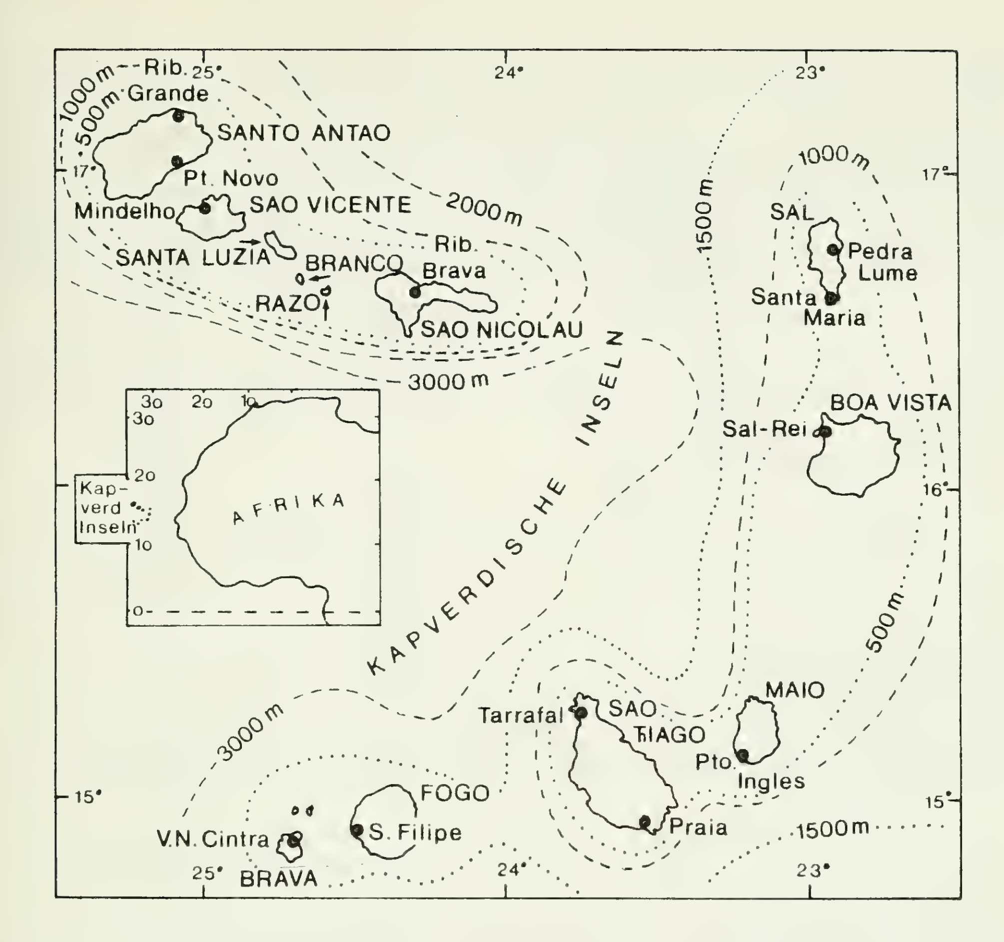
Einen Eindruck zur Klimatographie der Kapverden sollen folgende Angaben liefern:

Klimatologisch können die Kapverden als gemäßigt ozeanisch, aber mit einem sehr trockenen Klima betrachtet werden. Die Regenzeit fällt dabei in die heißeste Jahreszeit während der Monate Juli bis Oktober, während die kälteste Jahreszeit auf die Monate November bis Dezember kommt.

Aus den Klimatabellen des Meteorological Office sind für Mindelho (S. Vicente) und für Praia (S. Thiago) folgende Werte zu entnehmen:

Mindelho für die Zeitperiode von 1892 bis 1925:
tägl. Max. Temp.: 25 °C; monatl. Ø Max. Temp.: 30 °C
tägl. Min. Temp.: 20,6°C; monatl. Ø Min. Temp.: 14,4°C
bei einer durchschnittlichen monatlichen Niederschlagsmenge von 99,1 mm.

Praia für die Zeitperiode von 1904 bis 1930:
tägl. Max. Temp.: 27,2°C; monatl. Ø Max. Temp.: 32,2°C
tägl. Min. Temp.: 22,2°C; monatl. Ø Min. Temp.: 17,2°C
bei einer durchschnittlichen monatlichen Niederschlagsmenge von 259,1 mm.



Nach dem Annuario Climatológico de Portugal (1973, Vol. 27) können folgende jährliche Gesamtniederschlagsmengen für 1973 wiedergegeben werden:

S. Vicente (Mindelho) –
jährlicher Niederschlag: 1012,8 mm
mittl. Lufttemp. (°C): 21,4 (∅ Min.); 30,2 (Max.) – 6. Sept.
17,8 (Min.) – 20. Feb.

Sal –
jährlicher Niederschlag: 1008,6 mm
mittl. Lufttemp. (°C): 20,1 (∅ Min.); 31,4 (Max.) – 8. Sept.
26,2 (∅ Max.)
15,4 (Min.) – 16. Feb.

S. Thiago (S. Jorge dos Orgãos) –
mittl. Lufttemp. (°C): 18,3 (∅ Min.); 12,5 (Min.) – 21., 25. Jan.

Fogo (Monte Velha) –
mittl. Lufttemp. (°C): 11,0 (Min.); – 23. Jan.

Fogo (S. Felipe) –
mittl. Lufttemp. (°C): 25,8 (∅ Min.); 29,0 (Max.)
33,5 (Max.) – 8. Okt.
18,0 (Min.) – 6. Feb.

Nachstehende Tabelle (aus Sabina, A. A., 1977**) gibt die „Krisenjahre" der Inseln mit dem Ausbleiben der Regenzeit an:

mit 1jähriger Dauer (partiell)	mit 2–3jähriger Dauer (generell)	Jahre mit Regen	Jahre ohne Regen
1719	1748–1750	1775	1718
1754	1773–1775	1778	1743
1764	1789–1791	1855	1753
1814	1811	1864	1763
1825	1831–1833	1884	1772
1845	1864–1866	1886	1788
1850	1885	1887	1810
1875	1901–1903	1906	1813
1889	1921	1918	1824
1896–1900	1941	1919	1831
	1946–1948	1927	1845
	1951–1952	1928	1850
	1959–1960	1938	1854
	1962–1965	1943	1858
	1966–1967	1950	1863
	1968–1976	1951	1874
		1952	1883
		1953	1896
		1954	1902
		1955	1920
		1956	1932
		1957	1940
		1958	1941
			1946
			1947
			1949
			1959

2.3 Material und Methodik

Das gesammelte Material verteilt sich auf die jeweiligen Inseln wie folgt:

Insel	*Mabuya* Exemplare	*Tarentola* Exemplare	*Hemidactylus* Exemplare
Sal	9	–	7
Boa Vista	4	–	23
Maio	30	9	–
S. Thiago	47	9	2
Ilhéu St. Maria	11	–	–
Fogo	6	11	4
Brava	4	–	–
St. Antão	9	17	–
S. Vicente	3	11	4 (2)*
St. Luzia	9	10	–
Branco	5	18	–
Razo	14	27	7
S. Nicolau	7	11	–
Σ	158	123	47

* (BMNH, *Hemidactylus bouvieri bouvieri*)

** Eingesehen am Landwirtschaftsministerium Praia/CABOVERDE.

Auf verschiedenen Inseln oder insbesondere von Lokalitäten mit schwach oder aber schützenswert erscheinenden Populationen wurden aus Gründen des Artenschutzes, keine Tiere oder, falls unumgänglich, nur eine geringe Anzahl gefangen.

Die Bearbeitung beinhaltet neben der rein deskriptiven Darstellung Abbildungen zu den Zeichnungsmustern bzw. Färbungsvarianten jeweiliger Formen bzw. sind diese in den Tafeln dargestellt. Für die umfangreichen Untersuchungen der Gattungen *Mabuya* und *Tarentola* wurden bei ersterer 8 und bei letzterer 12 Parameter zur allometrischen Streckenerfassung gemessen. Soweit Tiere zur Beobachtung im Terrarium gehalten wurden, entstammten die Maßangaben von diesen lebenden Exemplaren, die nun von den konservierten Tieren verschieden sein können. Die Allometrieangaben beinhalten folgende Meßstrecken:

GL: Gesamtlänge = Schnauze–Schwanzspitze (KR + SL)
SL: Schwanzlänge = Strecke Kloakenspalt–Schwanzspitze
KR: Kopfrumpflänge = Strecke Schnauzenspitze–Kloakenspalt
KL: Kopflänge = Strecke Schnauzenspitze–post. Nuchaliagrenze
KB: Kopfbreite = Strecke über den Augen
A: Augdurchmesser
O: Ohrdurchmesser
OA: Strecke anteriorer Ohr–posteriorer Augrand
AS: Strecke Auge–Schnauzenspitze
MSP: Maulspaltlänge von Schnauzenspitze bis Mundwinkel
ML: Mentale-Länge
MB: Mentale-Breite (mittlere)

Anhand der gemessenen und auf Lochkarten gespeicherten Parameter wurden am Leibniz-Rechenzentrum (LRZ) München nach dem angebotenen Statistik-Programm-System SPSS 8 (NIE, N. H. & HULL, L. K., 1980) „Scattergrams" erstellt und daraus sowie über die Statistikprozedur „Pearson Correlation" die notwendigen statistischen Berechnungen[1]) gewonnen. Die dazugehörigen Reinzeichnungen der Diagramme[1]) wurden ebenfalls am selbigen Institut gefahren. Für die kollegiale Unterstützung bei der Durchführung dieser Arbeiten möchte ich Herrn W. SPIEGEL (München) herzlichst danken.

Die in den Diagrammen und variationsstatistischen Angaben verwendeten Abkürzungen lauten:

Gliederung zu den Diagrammen allometrischer Meßwerte an kapverdischen Skinken der Gattung *Mabuya* – Dargestellt wurden je 9 Diagramme mit folgenden Parametern:

GL/KR = Gesamtlänge : Kopfrumpflänge
SL/KR = Schwanzlänge : Kopfrumpflänge
KL/KR = Kopflänge : Kopfrumpflänge
A/KL = Augdurchmesser : Kopflänge
OA/KL = Strecke anteriorer Ohrrand–posteriorer Augrand : Kopflänge
A/O = Augdurchmesser : Ohrdurchmesser
KB/KL = Kopfbreite : Kopflänge
O/KL = Ohrdurchmesser : Kopflänge
A/OA = Augdurchmesser : Strecke OA

Gliederung zu den Diagrammen allometrischer Meßwerte an kapverdischen Geckos der Gattung *Tarentola* – Dargestellt werden je 12 Diagramme mit folgenden Parametern:

GL/KR = Gesamtlänge : Kopfrumpflänge
SL/KR = Schwanzlänge : Kopfrumpflänge
KL/KR = Kopflänge : Kopfrumpflänge
A/KL = Augdurchmesser : Kopflänge
OA/KL = Strecke Ohr–Auge : Kopflänge
AS/KL = Strecke Auge–Schnauzenspitze : Kopflänge

[1]) Aus finanziellen und drucktechnischen Gründen war eine Übernahme in vorliegender Arbeit nicht mehr möglich. Die Diagramme können zusammen mit den Berechnungen in der Bibliothek der ZSM eingesehen werden.

KB/KL = Kopfbreite : Kopflänge
O/KL = Ohrdurchmesser : Kopflänge
A/O = Augdurchmesser : Ohrdurchmesser
MSP/KL = Maulspaltlänge : Kopflänge
MSP/OA = Maulspaltlänge : Strecke OA
A/OA = Augdurchmesser : Strecke OA

Diagramme zur Allometrie und variationsstatistischen Analysen.

Die variationsstatistischen Angaben sind im Anschluß an die jeweiligen Diagramme eines Verbreitungsgebietes bzw. einer Art aufgeführt.

Ihre Abkürzungen lauten:

n = Anzahl der ausgewerteten Exemplare
P = Pearson Correlation; Grad der Beziehung zwischen 2 Variablengruppen
Corr = Korrelationskoeffizient
Intcp A = Schnittpunkt mit der y-Achse
Slope B = Steigung der Regressionsgeraden
Std. Err = geschätzter Standardfehler (= Std. Err. Est.)
Std. Err (A) = geschätzte Standardabweichung der y-Werte
Std. Err (B) = geschätzte Standardabweichung der x-Werte
MW = Mittelwert
Std. Dev. = Standardabweichung

Neben diesen statistisch verwerteten Messungen kommen noch folgende weitere Informationen zur Indikation und Beschreibung der jeweiligen Formen hinzu:

Anzahl der Schuppen um die Rumpfmitte
Anzahl der Supra/Sublabialia (OL/UL)
Anzahl der Aurikulartuberkel
Anzahl der Subdigitallamellen
Anzahl der Streifen- bzw. Bänder des Zeichnungsmusters.

Die dritte, hinter den Inventarnummern der ZSM erfolgte Durchnumerierung diente ebenfalls den statistischen Berechnungen bei der EDV.

3. Artenliste mit Merkmalscharakteristik und Verbreitungstabelle der kapverdischen Echsen

Scincidae:

Glatte bis schwach gekielte Schuppen, keine verbreiterten Finger mit Haftlamellen:

Nur 1 Gattung — Genus *Mabuya*

KR bis ca. 68 mm, 42–50 Schuppenreihen, dunkle Achselocellen, rostbrauner breiter, hell gesäumter Rückenstreifen — *M. delalandii*

KR bis ca. 80 mm, 58–60 Schuppenreihen um die Rumpfmitte, dunkel, fast melanotisch, Dorsalia ungekielt bis tricarinat; 3–6 anteriore Aurikulartuberkel — *M. fogoensis fogoensis*

KR bis ca. 87 mm, 52–60 Schuppenreihen um die Rumpfmitte, Dorsalia ungekielt bis doppelkielig, ♂♂ ventrolateral deutlich rot gefärbt; 2–3 anteriore Aurikulartuberkel — *M. fogoensis nicolauensis*

KR bis ca. 67 mm, 50–54 Rumpfschuppen, Dorsalia doppelkielig, sehr dunkel gefärbt; 3 anteriore Aurikulartuberkel — *M. fogoensis antaoensis*

KR bis max. 80 mm, meist 42–46 Schuppenreihen, je einen hellen Dorsolateralstreifen — *M. stangeri stangeri*

KR bis max. 80 mm, 36–40 Schuppenreihen, schwach tricarinat, helle Oberschenkelocellen *M. stangeri maioensis*

KR bis max. 87 mm, 36–44 Rumpfschuppen, zwei- bis dreikielig. Schmaler dunkler Dorsomedianstreifen, der von Dorsolateralstreifen gesäumt wird *M. stangeri salensis*

KR bis max. 70 mm, 34–38 Schuppenreihen, Dorsalia tricarinat, helle Schenkelocellen, Ohröffnung oft nur halber Augendurchmesser, *M. stangeri spinalis*

KR bis 122 mm, Schnauzenspitze orange, 50–56 Schuppenreihen, 3 helle Rückenstreifen *M. vaillanti*

Gekkonidae:

Finger und Zehen verbreitert, mit Subdigitallamellen

Subdigitallamellen ungeteilt Genus *Tarentola*

Subdigitallamellen geteilt Genus *Hemidactylus*

Genus *Tarentola*

KR-Länge adulter Tiere zwischen 55 bis 72 mm, 12–18 Tuberkelreihen, Mentalialänge entspricht etwa doppelter Mentaliabreite, 4–5 Rückenbänder *Tarentola rudis*

Verhältnis von Supra-/Sublabialia 9/11 bis 7/11; 16–18 Tuberkelreihen, ca. 72 mm max. KR-Länge, 4–5 Rückenbänder *T. rudis rudis*

KR-Länge bis ca. 68 mm, 12–18 Tuberkelreihen, meist jedoch 14, Verhältnis von Supra-/Sublabialia 8/9 bis 7/8; 5 Rückenbänder *T. rudis maioensis*

KR-Länge max. 98,5 mm, 144–181 Schuppen um die Körpermitte, Verhältnis Supra-/Sublabialia 11(–9)/11(–7), 16 Tuberkelreihen, 4–5 Rückenbänder *T. rudis protogigas*

Beschuppung „samtig", perlgrau, 14–18, meist 16 Tuberkelreihen; bis ca. 54 mm KR-Länge, Supra-/Sublabialia 8/13 bis 7/10; 4, meist 5 Transversalbänder *Tarentola darwini*

KR-Länge max. bis 60 mm, 14–20 relativ kräftige Tuberkelreihen, 3–6 Rückenbänder, Mentale länger als seine halbe Breite *Tarentola caboverdiana*

KR-Länge max. bis 48 mm, 14–16 Tuberkelreihen (meist 16!), 5(4)–6 Bänder, meist 5. *T. caboverdiana caboverdiana*

KR-Länge max. bis ca. 54 mm, 14 bis meist 18 Tuberkelreihen, 4–6, meist 5 Transversalbänder *T. caboverdiana nicolauensis*

KR-Länge max. bis ca. 53 mm, 16(–18) Tuberkelreihen, 3–4 Transversalbänder *T. caboverdiana raziana*

KR-Länge max. 60 mm, 146–167 Schuppen um die Körpermitte, Vorderbeine kürzer als Kopflänge, Verhältnis Supra-/Sublabialia 11(–8)/9(–7), 14–20 Tuberkelreihen, 4–5 Rückenbänder *T. caboverdiana substituta*

Kräftig gackernde Stimme, massige große Tiere, KR bis ca. 135 mm, Mentalelänge mehr als doppelte Breite *Tarentola gigas*

KR-Länge bis ca. 135 mm *T. gigas gigas*

KR-Länge bis ca. 114 mm *T. gigas brancoensis*

Genus *Hemidactylus*

Rosa bis graubraun mit warzigen Tuberkeln *Hemidactylus brooki angulatus*

Einfarbig bis bunt gezeichnet, glatte Schuppen *Hemidactylus bouvieri*

Vorkommen / Taxa	S. Antao	S. Vicente	St. Luzia	Branco	Razo	S. Nicolau	Sal	Boa Vista	Maio	S. Thiago	St. Maria	Fogo	Brava	Rhombos
REPTILIA - SCINCIDAE														
Mabuya delalandii								●		●	●	●	●	○
Mabuya fogoensis	●	○				●						●		
Mabuya fogoensis fogoensis												●		
Mabuya fogoensis antaoensis	●													
Mabuya fogoensis nicolauensis						●								
Mabuya stangeri		●	●	●	●		●	●	●	●	●	●	○	
Mabuya stangeri stangeri		●	●	●	●		○	○					○	
Mabuya stangeri maioensis									●					
Mabuya stangeri salensis							●	●						
Mabuya stangeri spinalis							○			●	●	●		
Mabuya vaillanti										●		●		○
REPTILIA - GEKKONIDAE														
Tarentola caboverdiana	●	●	●		●	●								
Tarentola caboverdiana caboverdiana	●													
Tarentola caboverdiana nicolauensis						●								
Tarentola caboverdiana raziana			●		●									
Tarentola caboverdiana substituta		●												
Tarentola darwini										●		○		
Tarentola gigas				●	●									
Tarentola gigas gigas					●									
Tarentola gigas brancoensis				●										
Tarentola rudis			○				○	○	●	●	●	●	○	○
Tarentola rudis rudis			○				○	○	○	●	●		○	
Tarentola rudis maioensis								○	●					
Tarentola rudis protogigas											●	●	○	○
Hemidactylus bouvieri	○	●			●		●	●		○	○	○	○	
Hemidactylus bouvieri bouvieri	○	●								○		○	○	
Hemidactylus bouvieri boavistensis							●	●						
Hemidactylus bouvieri razoensis					●									
Hemidactylus brooki angulatus	○	●					●	○		●	○	●	○	○

● = in vorliegender Arbeit behandelt u. nachgewiesen (s.a. SCHLEICH, 1982)

○ = Vorkommen wahrscheinlich oder von vorhergehenden Autoren angeführt; als Neunachweis bislang noch nicht bestätigt

KR-Länge bis ca. 38 mm — *H. bouvieri bouvieri*
KR-Länge bis ca. 50 mm — *H. bouvieri boavistensis*
KR-Länge bis ca. 29 mm — *H. bouvieri razoensis*

4. Systematischer Teil

4.1 Scincidae – Genus *Mabuya*

Nach intensiven Recherchen und Nachforschungen zur Überlebensfrage von *Macroscincus coctei,* dem kapverdischen Riesenskink, wird dieser von mir (s. Schleich 1982 b) als ausgestorben betrachtet. Die einzig verbleibende Skinkgattung *Mabuya* kommt nach meinen Untersuchungen mit 4 Arten und 9 Unterarten/Arten vor.

4.1.1 *Mabuya delalandii* (Dumeril & Bibron, 1839). (Taf. I, Fig. 1)

Material:
4 Ex. ZSM 367/1978; Brava. 7 Ex. ZSM 5/1982; S. Thiago-Praia, Flughafen. 12 Ex. ZSM 7/1982; S. Thiago-Praia, Stadt. 4 Ex. ZSM 369/1978; S. Thiago-C. Velha. 1 Ex. ZSM 154/1981; S. Thiago-Tarrafal. 2 Ex. ZSM 157/1981; S. Thiago-St. Cruz. 2 Ex. ZSM 8/1982; Ilheu St. Maria (S. Thiago). 4 Ex. ZSM 11/1982; Fogo-S. Felipe. 3 Ex. ZSM 373/1978; Boa Vista. 5 Ex. ZSM 155/1981; S. Thiago – 5 km S.-Tarrafal.

1839 *Euprepis delalandii* Dumeril & Bibron
1845 *Euprepis delalandii.* – Gray
1845 *Euprepis belcheri.* – Gray
1857 *Euprepis venustus.* – Girard
1867 *Euprepis delalandii.* – Bocage
1869 *Euprepis delalandii.* – Peters
1875 *Euprepis delalandii.* – Bocage
1887 *Mabuya vaillanti.* – Boulenger (non del.)
1935 *Mabuya delalandei.* – Angel
1937 *Mabuya vaillanti.* – Angel (non del.)
1951 *Mabuya delalandei.* – Dekeyser & Villiers
1955 *Mabuya delalandii.* – Mertens
1976 *Mabuya delalandii.* – Greer
1982b *Mabuya delalandii.* – Schleich

Terra typica: Cap de Bonne Esperance
Bisherige Verbreitung: S. Thiago, Fogo, Brava, Rhombos
Nachgewiesen von: S. Thiago, Ilhéu St. Maria, Fogo, Brava, Boa Vista

Artcharakteristika nach:

Mertens (1955) –
14 Exemplare, von verschiedenen Inseln; (er bezeichnet seine 6 Stücke von Praia als Topotypen).
Frontoparietalia sowie Parietalia mit Interparietalia zu einem Schild verschmolzen. 5. (6.) Supralabiale ist eigentlich Suboculare. Zwischen 48 und 52 Rückenschuppen, dorsal scharf dreikielig, heller Dorsolateralstreifen gezackt abgegrenzt.

Greer (1976) –
KR: 80 mm. Schuppenreihen um Körpermitte: 46–52

Dekeyser & Villiers (1951) –
18 Exemplare; min. 48, max. 80 mm (74 mm; reg. Schwanz). MW: 67,7 mm KR-Länge. 46 Schuppenreihen um den Körper, Verbreitung: Brava, Fogo, Rhombos, S. Thiago

Angel (1935) –
Frontoparietalia verwachsen, 46–50 Schuppen um die Körpermitte, 5. Labiale viel größer als 6., bildet Subokulare. Augdurchmesser gleich Ohrdurchmesser

Diagnose:

KR-Länge bis ca. 80 mm, SL ca. 1,6× KR. 42–50 (?52) Schuppenreihen um die Rumpfmitte.

Ohrdurchmesser gleich oder nur geringfügig kleiner als Orbit. 7–8 Supra- bei 6–7 Sublabialia. 5. Supralabiale vergrößert unter dem Auge. Dorsalia 2–3 kielig, Ventralia glatt. Interparietale mit Parietale verschmolzen; darauf Pinealforamen. Braune Rückenfärbung, mit einem Dorsalstreifen mit lateraler Begrenzung durch helle Streifen. Ventral beige; dunkle Achselocellen.

Beschreibung:

Anmerkung

Von der vor Praia (São Thiago) liegenden kleinen Insel St. Maria, sowie von Brava und Boa Vista konnte *Mabuya delalandii* nachgewiesen werden. Für Boa Vista ist dies ein Neunachweis.

Habitus

Der allgemeine Habitus von *Mabuya delalandii* ist von kräftiger, mittelgroßer Gestalt. Während der Kopf gut bis weniger stark vom Rumpf abgesetzt ist, ist dies beim Schwanz meist deutlich der Fall. Die Schwanzlänge beträgt immer weniger als die anderthalbfache KR-Länge. Die Beine sind kurz, der Schwanz rund bis dorsoventral abgeflacht. Die ♂♂ sind von den ♀♀ durch ihre dickere Wangenpartie und den so breiter erscheinenden Kopf unterscheidbar.

Pholidose

Zwischen 42 bis max. 50 Schuppen können um die Rumpfmitte gezählt werden, wenngleich sich auch bei Populationen bestimmter Verbreitungsgebiete enger begrenzte Schuppenzahlen zu stabilisieren scheinen. So konnten für Brava und Boa Vista wie auch für die kleine vor Praia liegende Insel St. Maria bei *Mabuya delalandii* 44–50 Schuppen gezählt werden, wo hingegen die Tiere von S. Thiago (5 km S-Tarrafal) 44 Schuppen aufweisen.

Generell können 8 Supra- und 6 Sublabialia ausgebildet sein, wo wiederum auch eine deutliche Häufung von Exemplaren mit je 7 Supra- und 6 Sublabialia auffällig ist.

Die Dorsalschuppen sind im Normalfall drei-, seltener zweikielig, die Ventralia glatt. Die Pileuspholidose ist neben der Färbung wohl das deutlichste Artmerkmal. Zwischen drei und fünf vordere Ohrrandtuberkel sind ausgebildet. Von den meist sechs Supralabialia ist das fünfte oft deutlich vergrößert und liegt direkt unter dem Auge. Eine transparente, relativ klare Palpebralschuppe ist ausgebildet. Die Supranasalia trennen das Rostrale vom Frontonasale, welches wieder durch die Präfrontalia vom Frontale getrennt ist. Vier Supraocularia und bis zu 6 Supraciliaria sind ausgebildet. Nur ein, meist trapezförmiges, Frontoparietale ist typisch. Das Interparietale ist mit den Parietalia zu einer großen halbmondförmigen Schuppe verschmolzen, worauf ein Pinealforamen ausgebildet ist. Zwei Nuchalia begrenzen caudal die Pileuspholidose.

Färbung

Die Tiere sind dorsal hell- bis kupferbraun, ventral cremefarben bis gelbbraun. Unter den Achseln sind typische dunkle Achselocellen ausgebildet. Die Zeichnung besteht fast ausnahmslos aus dem breiten unifarbenen Rückenlängsstreifen, der dorsolateral von zwei hellen, weißlichen Streifen begrenzt ist. Diese beginnen über den Augen und ziehen bis zur Schwanzbasis, meist von einer dunkelbraunen Punktreihe gesäumt. Lateral schließt ein dunkler – meist dunkler als die Rückenfärbung – Flankenstreifen an, der vom Rostrale bis zur Schwanzbasis zieht. Ventrolateral kann daran noch ein weißlicher Streifen folgen, meist aber schließt direkt an den dunklen Flankenstreifen eine dunkelbraune Tüpfelung an, die sich auch auf den Kehlbereich ausdehnen kann. Die Ventralseite ist bis auf eben den bei einigen Individuen getüpfelten Kehlbereich einfarbig hell.



Tafel I

Tafel I: Fig. 1: *Mabuya delalandii* von S. Thiago. Fig. 2: *Mabuya vaillanti* von S. Thiago. Fig. 3: *Mabuya stangeri spinalis* von S. Thiago. Fig. 4: *Mabuya stangeri salensis* von Sal. Fig. 5: *Mabuya stangeri maioensis* von Maio. Fig. 6: *Mabuya fogoensis fogoensis* von Fogo. Fig. 7: *Mabuya fogoensis nicolauensis* von S. Nicolau. Fig. 8: *Mabuya stangeri stangeri* von Branco.

Maßtabelle

Mabuya delalandii von S. THIAGO – Praia, Flughafen

Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	OL/UL	n Schuppen
5.82.7	114,0	40,0	74,0	8,0	5,0	1,6	2,2	4,0	7/7	43
5.82.6	146,0	56,0	90,0	12,5	7,5	2,6	3,0	4,1	8/7	44
5.82.5	152,0	54,0	98,0	11,3	6,1	1,7	2,7	5,0	7/6	43
5.82.4	179,0	78,0	101,0	14,0	8,4	1,5	3,5	6,5	8/7	42
5.82.3	178,0	73,0	105,0	15,0	8,6	1,8	3,7	6,0	7/6	42
5.82.2	192,0	78,0	114,0	13,5	10,0	1,6	3,6	6,5	7/6	42
5.82.1	185,0	75,0	110,0	14,8	11,0	2,7	3,0	7,0	7/6	42
– Praia, Stadt										
7.82.12	108,0	40,0	68,0	9,8	5,8	0,0	0,0	0,0	–	–
7.82.11	116,0	53,0	63,0	11,4	6,3	1,5	3,0	4,2	7/6	46
7.82.10	148,0	51,0	97,0	11,4	6,0	1,5	2,5	4,0	7/6	–
7.82.9	151,0	55,0	–	11,3	6,6	0,0	0,0	0,0	–	–
7.82.8	–	76,0	–	14,6	9,5	2,0	3,3	6,7	7/6	46
7.82.7	–	80,0	–	17,0	11,0	1,9	3,7	6,5	7/6	46
7.82.6	–	68,0	–	12,7	7,5	2,1	3,2	5,5	7/6	46
7.82.5	165,0	60,0	105,0	12,8	7,2	2,0	2,5	5,5	6/6	48
7.82.4	175,0	64,0	111,0	11,9	8,0	2,0	2,5	5,3	7/7	47
7.82.3	–	72,0	–	14,4	10,2	2,4	3,3	6,0	7/7	47
7.82.2	–	72,0	–	14,7	10,3	2,1	3,5	5,6	7/7	48
7.82.1	–	80,0	–	14,5	11,7	2,3	3,5	6,1	8/7	48
– Cidade Velha										
369.78.3	130,0	52,0	78,0	11,5	7,0	1,8	2,5	4,5	7/7	42
369.78.2	99,0	44,0	55,0	10,0	5,5	1,2	2,3	3,1	7/6	44
369.78.1	135,0	54,0	81,0	12,0	6,8	1,5	2,3	4,0	7/7	42
– Tarrafal										
154.81.1	186,0	76,0	110,0	15,5	11,5	3,0	3,0	7,0	7/7	44
– 5 km S-Tarrafal										
155.81.5	–	75,0	–	15,5	11,5	2,9	3,1	5,8	7/7	44
155.81.4	176,0	73,0	103,0	15,0	11,8	2,5	3,0	6,8	7/7	44
155.81.3	188,0	77,0	111,0	15,5	11,5	2,5	3,5	6,6	7/6	44
155.81.2	200,0	75,0	125,0	14,2	9,5	2,8	3,2	6,0	7/7	44
155.81.1	–	68,0	–	12,2	8,5	2,5	3,1	5,2	7/6	44
– St. Cruz										
157.81.2	–	78,0	–	16,0	11,0	2,8	3,6	6,5	7/7	44
157.81.1	173,0	71,0	102,0	13,5	9,0	2,5	3,2	5,8	7/6	46
von ILHÉU ST. MARIA										
8.82.2	–	68,0	–	8,0	13,9	1,5	2,9	5,7	7/6	44
8.82.1	186,0	72,0	114,0	15,0	10,4	2,3	3,1	6,1	7/6	48
von FOGO										
11.82.4	120,0	48,0	72,0	11,0	6,0	1,8	2,0	4,2	8/7	46
11.82.3	120,0	50,0	70,0	11,8	6,0	1,6	2,0	4,0	7/6	46
11.82.2	116,0	52,0	64,0	10,5	6,3	2,0	2,3	4,1	7/6	50
11.82.1	135,0	51,0	84,0	11,0	6,3	1,8	2,0	4,5	8/7	46

	von BRAVA									
367.78.4	(114,0)	46,0	(68,0)	10,5	5,8	1,7	2,0	3,7	7/6	46
367.78.3	–	72,0	–	13,5	10,0	2,1	2,3	6,2	8/7	46
367.78.2	–	75,0	–	14,6	11,2	2,0	2,1	6,3	8/7	50
367.78.1	–	80,0	–	15,5	12,8	3,0	3,0	7,0	7/6	48
	von BOA VISTA									
373.78.3	110,0	46,0	64,0	10,0	6,5	1,4	2,0	3,9	8/7	42
373.78.2	–	43,0	–	10,2	6,0	1,5	2,1	4,0	8/7	42
373.78.1	–	58,0	–	13,0	8,0	1,8	–	4,9	8/7	44

4.1.2 *Mabuya fogoensis* (O'Shaugnessy, 1874)

1874 *Euprepes fogoensis* O'Shaugnessy
1887 *Mabuya fogoensis.* – Boulenger
1935 *Mabuya fogoensis.* – Angel
1937 *Mabuya fogoensis.* – Angel
1951 *Mabuya fogoensis.* – Dekeyser & Villiers
1955 *Mabuya fogoensis.* – Mertens
1976 *Mabuya fogoensis.* – Greer
1982 *Mabuya fogoensis.* – Schleich

Terra typica: Fogo, Sao Vicente
Bisherige Verbreitung: Fogo, St. Antão, Sao Vicente, San Nicolau
Nachgewiesen von: Fogo, San Nicolau, St. Antão

Artcharakteristika nach:

Mertens (1955) –
60–66 Schuppenreihen, Schuppen dorsal zweikielig bis undeutlich dreikielig; Neigung zum Melanismus; Kopfunter-, Bauchseite dunkelgrau bis schwarz gefleckt. KR: 66 mm, SL: 95 mm

Greer (1976) –
KR: 78 mm, 60–66 Schuppenreihen

Dekeyser & Villiers (1951) –
46 Exemplare; KR max: 81 mm, min. 54 mm; KR – MW: 67,2 mm, zwischen 53 und 68 Schuppenreihen

4.1.2.1 *Mabuya fogoensis fogoensis* (O'Shaugnessy, 1874) (Taf. I, Fig. 6)

Material: 4 Exemplare BMNH 1946 8.18.8–11.
Terra typica: Fogo
Bisherige Verbreitung: Fogo
Nachgewiesen von: Fogo

Diagnose:

KR-Länge ca. 80 mm, Schwanzlänge ca. 1,1× KR-Länge. 58–60 Schuppenreihen um die Rumpfmitte; Dorsalia ungekielt bis schwach dreikielig; 7 Supra- und 6 Sublabialia; 4 Supraocularia. 3–6 anteriore Aurikulartuberkel. Dunkelbraun mit Tüpfelung oder Flankenstreifen.

Beschreibung:

Habitus

Die Skinke sind von lacertiformem Habitus mit abgesetztem Kopf und rundem Schwanz. Die KR-Länge beträgt max. ca. 8 cm bei 17 bis 18 cm Gesamtlänge. Die Ohröffnung ist etwa gleich groß wie der Augdurchmesser.

Pholidose

58–60 Schuppen werden um die Rumpfmitte gezählt. Die Dorsalschuppen sind ungekielt bis schwach dreikielig, die Ventralia glatt. 8–10 vergrößerte Präanalschuppen und je 7 Supra- und Subla-

bialia (1×6), sowie 3–6 sehr kleine, vordere Ohrrandschuppen sind ausgebildet. Das 5. Supralabiale ist vergrößert und liegt direkt unter dem Auge. Die transparente Palpebralscheibe ist relativ groß. 4 Supraocularia und 6 Supraciliaria können gezählt werden. Das Interparietale mit einem schwach sichtbaren Pinealforamen ist deutlich kleiner als die beiden Frontoparietalia. Die Parietalia sind sehr groß und umgreifen fast das Interparietale. Posterocranial begrenzen zwei Nuchalia die Pileuspholidose.

Färbung

Typisch für die 4 Alkohol-Exemplare aus der Sammlung des BMNH ist eine dunkelbraune Tüpfelung auf hellbraunem Grund. Dabei sind die Flecken dorsal in 2 Doppeltüpfelreihen, die meist einen hellen kleineren Mittel- oder Randfleck aufweisen, angeordnet. Dorsolateral tritt dieses gleiche Zeichnungsmuster – in einer intensivierten Dunkelfärbung zuweilen auf einem dunkleren Farbrand – das vom Auge bis zum Schenkelansatz reicht, auf. Die Flanken sind gesprenkelt, der Kopf gelblich braun.

Maßtabelle

Mabuya fogoensis fogoensis von FOGO

BMNH-Inv. Nr.	GL	KR	SL	KL	KB	O	A	OA	OL/UL	n Schuppen
1946.8.18.8	173,0	80,0	93,0	16,5	11,2	2,2/0	3,1	6,8	7/6	60
1946.8.18.9	173,0	76,0	97,0	15,5	11,0	2,6/4	3,0	6,6	7/6	58
1946.8.18.10	–	66,0	–	14,0	9,5	2,0/3	2,9	5,9	7/6	58
1946.8.18.11	108,0	58,0	50,0	13,0	8,0	2,0/2	2,6	5,1	7/6	58

4.1.2.2 *Mabuya fogoensis nicolauensis* **nov. ssp.** (Taf. I, Fig. 7)

Material: 7 Exemplare; Holotypus – ZSM 1.82.1, S. Nicolau. Paratypen – ZSM 1.82.2–7.
Terra typica: S. Nicolau
Verbreitung: S. Nicolau
Derivatio nominis: *nicolauensis,* von S. Nicolau

Diagnose:

KR-Länge bis 87 mm; zwischen 52–60 Schuppen um die Körpermitte. In der Regel 7 Supralabialia. 2–3 anteriore Aurikulartuberkel. Dorsalia ungekielt bis doppelkielig; Ventralia glatt. Bei ♂♂ auffällige Rotfärbung der Bauchseite.

Beschreibung des Holotypus:

Der Holotypus ist das größte Individuum der gefangenen Serie von sieben Exemplaren. Seine Gesamtlänge beträgt 16,4 cm, wobei 8,7 cm auf die Kopf-Rumpflänge entfallen; 5,5 cm der Schwanzlänge sind regeneriert. Die Kopflänge mißt 17,5 mm bei 13,0 mm Breite. Ohr- und Augdurchmesser sind mit je 3,1 mm gleich groß. Sieben Supra- und Sublabialia sind ausgebildet, um die Rumpfmitte zählt man 54 Schuppen. Das Exemplar ist dorsal braun gefärbt und trägt die zwei typischen hellen Dorsolateralstreifen, die zu den Flanken hin mit einer dunklen Punktreihe gesäumt sind. Die hellen Streifen reichen vom hinteren Augenwinkel bis auf den Schwanz. Die mittlere linke Zehe ist kupiert, ebenfalls der linke Hemipenis. Ventral ist das Tier ab den Vorderextremitäten rötlich beige gefärbt mit einer lateralen Rotintensivierung.

Beschreibung:

Habitus

Der Habitus der max. bis 87 mm (KR) lang werdenden Tiere ist von typisch lacertider Form mit vom Rumpf abgesetzten Kopf und Schwanz. Insbesondere bei den adulten ♂♂ ist deutlich die Wangenregion verdickt. Der Schwanz ist dorsolateral rundlich und mit basaler Abflachung.

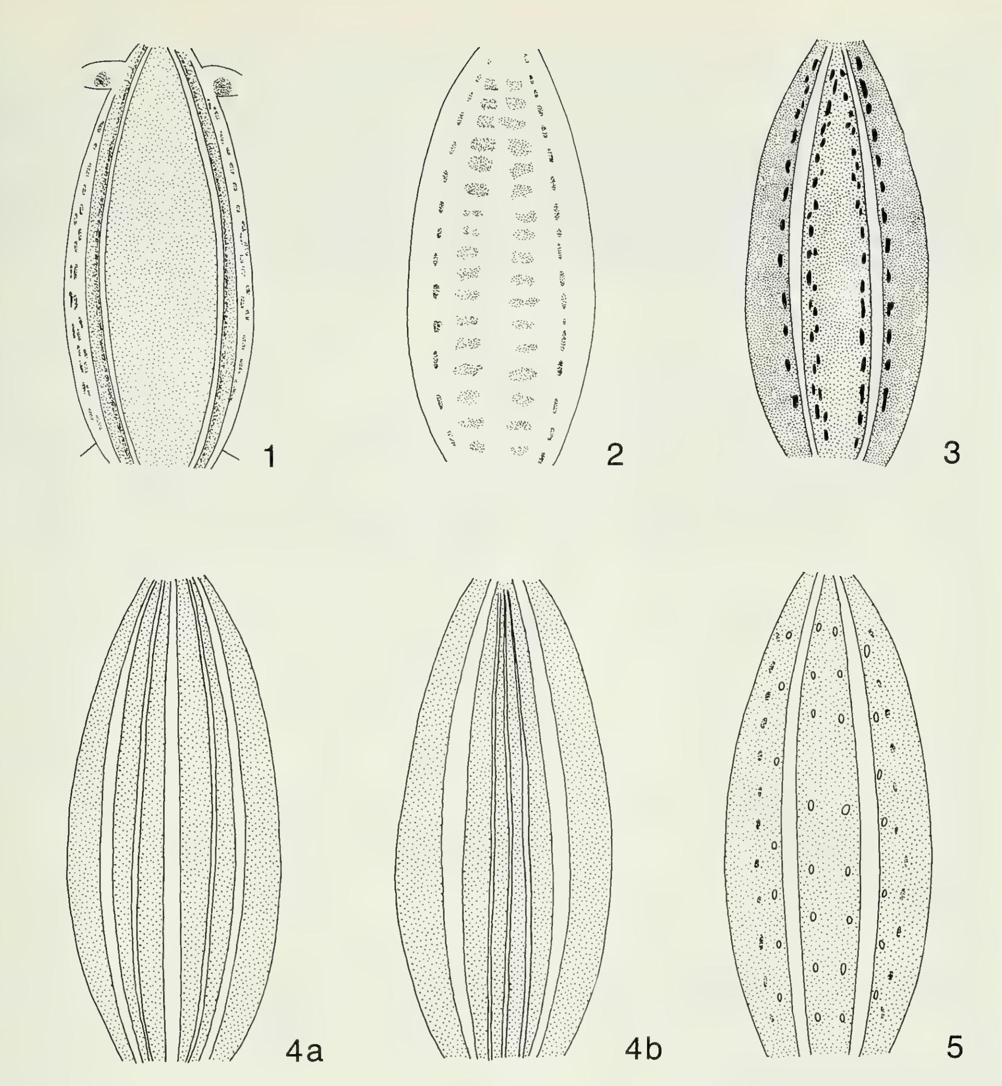


Abb. 1–5: Schematisierte Rückenzeichnungen kapverdischer Skinke der Gattung *Mabuya.* 1) *Mabuya delalandii;* 2) *Mabuya fogoensis fogoensis;* 3) *Mabuya fogoensis nicolauensis;* 4a, b,) *Mabuya fogoensis antaoensis;* 5) *Mabuya stangeri stangeri.*

Pholidose

52–60 Schuppen können um die Rumpfmitte gezählt werden. Von den Lippenschildern sind mit je einer Ausnahme (1×8 Supralabialia, 1×6 Sublabialia) 7 ausgebildet.

Das Augenlid bedeckt eine relativ große, klare Palpebralscheibe. Den vorderen Ohrrand zieren meist nur 2–3 kleine Spinalschuppen. Zwei Supranasalia trennen das Rostrale vom Frontonasale. Die Frontoparietalia sind nur wenig größer als das Interparietale. Vier Supraocularia sind vorhanden. Zwei Nuchalia begrenzen caudal die Schädelpholidose. Die Dorsalschuppen weisen, falls überhaupt erkennbar, nur eine schwache Doppelkielung auf, die Ventralia sind glatt.

Färbung

Vier der konservierten Exemplare zeigen eine deutlich orange-rote Kehl- und Bauchfärbung. Möglicherweise handelt es sich bei dieser Färbung um einen Geschlechtsdimorphismus, da alle vier Exemplare ausgestülpte Hemipenes zeigen, während die drei verbleibenden kleineren Exemplare ventral nur gräulich gefärbt sind. Alle Exemplare zeigen zwei helle Lateralstreifen, die zur Rückenmitte von dunkelbraunen Tupfen gesäumt werden und an den Flanken von einer feinen, abwechselnd dunkelbraunen, hellbeigen Tüpfelung begrenzt sind. Helle Tüpfel zieren die Caudalseiten der Oberarme. Die Rückengrundfärbung ist mitteldunkelbraun, die Flecken sind graubraun.

Maßtabelle

Mabuya fogoensis nicolauensis nov. ssp. von S. NICOLAU

Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	OL/UL	n Schuppen
1.82.1	–	87,0	–	17,5	13,0	3,1	3,1	7,2	7/7	54
1.82.2	164,0	72,0	92,0	14,0	11,4	2,6	2,8	6,2	7/7	54
1.82.3	159,0	64,0	95,0	13,1	8,7	2,4	2,6	5,5	7/7	60
1.82.4	147,0	58,0	89,0	11,5	7,0	1,8	2,2	4,7	7/6	52
1.82.5	121,0	49,0	72,0	10,8	6,5	2,0	3,0	4,1	7/7	52
1.82.6	94,0	42,0	52,0	10,0	53,0	12,0	19,0	3,2	7/7	54
1.82.7	–	52,0	–	11,3	7,1	2,0	0,0	4,2	8/7	52
BMNH-Inv. Nr.										
1906.3.30.36	160,0	72,0	80,0	15,0	11,0	2,5/3	3,0	6,0	7/7	58

4.1.2.3 *Mabuya fogoensis antaoensis* **nov. ssp.**

Material: 9 Exemplare; Holotypus – ZSM 23.1982.1. Paratypen – ZSM 23.1982.2–9.
Terra typica: St. Antão
Verbreitung: St. Antão
Derivatio nominis: *antaoensis*, von St. Antão

Diagnose:

KR-Länge bis ca. 67 mm, SL meist ca. 1,3–1,5× KR; 50–54 Schuppen um die Rumpfmitte. In der Regel 7 Supra- und 6 Sublabialia; 3 anteriore Aurikulartuberkel. Dorsalia doppelkielig; Ventralia glatt.

Beschreibung des Holotypus:

Als Holotypus wurde das Exemplar mit der größten KR-Länge gewählt. Seine Gesamtlänge beträgt 13,6 cm bei 6,7 cm KR-Länge, wobei 4 cm auf das Schwanzregenerat entfallen.

Das Tier ist dunkelbraun und erscheint am Rücken nur sehr schwach gezeichnet. Lateroventral löst sich die Färbung in eine unregelmäßige Fleckenreihe auf; dieselbe Fleckung erstreckt sich auch auf den gesamten Kehlbereich. Die Bauchmitte sowie die Extremitätenunterseite sind hellbeige/grau gefärbt. Auf dem heller gefärbten Schwanzregenerat wird die Streifung wieder deutlicher. Weitere allometrische Werte sind nachfolgender Maßtabelle zu entnehmen.

Beschreibung:

Habitus

Das von der Ostseite von St. Antão stammende Material umfaßt eine kleine Serie von 9 Skinken juveniler bis adulter Tiere. Ihrer phänotypischen Erscheinung nach gleichen sie sehr denen von S. Vicente. Mit 67 mm KR-Länge erscheint das größte ♂ vom Körperbau her bedeutend gedrungener als ein vergleichbares Exemplar von S. Nicolau. Der Kopf erscheint kürzer als bei besagter Form und ist

ebenso wie der Schwanz nur undeutlich vom Rumpf abgesetzt. Der Körper ist ziemlich gleichförmig, der Schwanz rund.

Pholidose

Zwischen 50 und 54 Schuppen können um die Rumpfmitte gezählt werden. 7 Supra- und 6 (eine Ausnahme mit 7) Sublabialia sind ausgebildet. Das Augenlid besitzt eine klare Palpebralscheibe; am vorderen Ohrrand sind 3 Spinalschuppen vorhanden. Die Dorsalschuppen sind doppelkielig, die Ventralia glatt. Die Supranasalia trennen das Rostrale vom Frontonasale. Die Zahl der Supraocularschilder beträgt 4. Die Frontoparietalia sind nur geringfügig größer als das Interparietale. Die Pileuspholidose wird durch zwei Nuchalia begrenzt.

Färbung

Die Tiere sind von tief dunkelbrauner Grundfärbung am Rücken und den Flanken, die Bauchseite ist dunkel graubraun.

Bis auf ein Exemplar ist der Mittelstreifen nur als dünner heller Strich, zuweilen ganz als Strichlinie ausgebildet. Seitlich davon liegen ebenfalls in mehr oder wenig deutlicher Ausbildung noch je zwei feine helle Streifen, die oft auch nur als Punktlinien angedeutet sein können. Die Flanken sind leicht hell gesprenkelt. Der Übergang zur helleren Bauchfärbung erfolgt meist erst auf der Ventralseite und nicht scharf begrenzt. Die Kehle erscheint ebenfalls deutlich marmoriert.

Maßtabelle

Mabuya fogoensis antaoensis nov. ssp. von ST. ANTÃO

Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	OL/UL	n Schuppen
23.82.9	122,0	47,0	75,0	10,5	6,5	1,6	2,0	3,3	7/6	50
23.82.8	–	42,0	–	8,8	5,5	–	–	–	–	–
23.82.7	102,0	38,0	64,0	9,0	5,5	–	–	–	–	–
23.82.6	100,0	43,0	57,0	10,0	5,5	–	–	–	–	–
23.82.5	–	53,0	–	12,0	7,3	2,2	2,6	5,0	7/6	50
23.82.4	104,0	42,0	62,0	10,2	6,5	1,9	2,2	4,0	7/6	54
23.82.3	100,0	43,0	57,0	10,0	6,5	2,0	2,0	3,8	7/6	52
23.82.2	–	63,0	–	12,5	8,2	2,3	2,5	4,0	7/6	50
23.82.1	–	67,0	–	13,3	9,3	2,0	2,5	5,5	7/7	54

4.1.3 *Mabuya stangeri*

4.1.3.1 *Mabuya stangeri stangeri* (Gray, 1845) (Taf. I, Fig. 8)

Material: 3 Ex. ZSM 159/81; S. Vicente. 3 Ex. ZSM 15/82; Branco. 3 Ex. ZSM 14/82; Branco. 14 Ex. ZSM 3/82; Razo. 1 Ex. ZSM 13/82; Razo. 2 Ex. ZSM 12/82; Razo. 11 Ex. ZSM 2/82; St. Luzia.

1845 *Euprepis stangeri* Gray
1869 *Euprepis polylepis.* – Peters
1875 *Euprepis hopfferi.* – Bocage
1887 *Mabuya stangeri.* – Boulenger
1937 *Mabuya stangeri.* – Angel
1951 *Mabuya stangeri.* – Dekeyser & Villiers
1955 *Mabuya stangeri stangeri.* – Mertens
1976 *Mabuya stangeri.* – Greer

Terra typica: Westafrika
Bisherige Verbreitung: (?) Sal, (?) Boa Vista, (?) Brava, S. Vicente St. Luzia, Branco, Razo
Nachgewiesen von: S. Vicente, St. Luzia, Branco, Razo

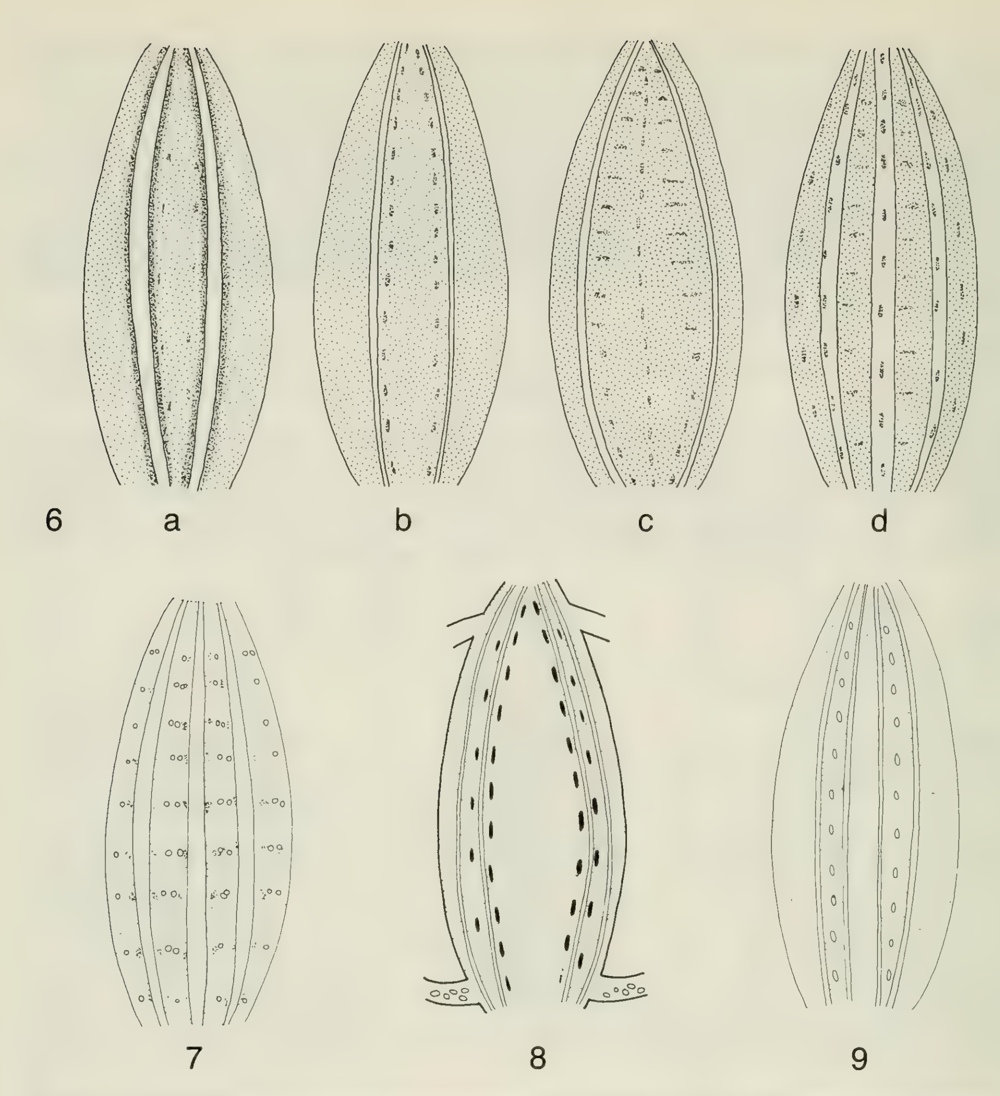


Abb. 6–9: Schematisierte Rückenzeichnungen kapverdischer Skinke der Gattung *Mabuya.* 6a–d) *Mabuya stangeri maioensis;* 7) *Mabuya stangeri salensis;* 8) *Mabuya stangeri spinalis;* 9) *Mabuya vaillanti.*

Artcharakteristika nach:

MERTENS (1955) – von 54 Exemplaren:

42–46 Schuppenreihen, dreikielig; 5–7 Supraciliaria, 5–6 Labialia unter dem Auge, Praefrontale kann mit den Frontoparietalia und das Interparietale mit dem Parietale verschmolzen sein.

GREER (1976) –

KR-Länge für *M. stangeri:* 90 mm. 36–46 Körperschuppen um die Rumpfmitte.

DEKEYSER & VILLIERS (1951) –

Verbreitung: S. Vicente, Branco, Razo, Sal, Boa Vista, Brava.

KR: max. 90 mm, min. 50 mm. 49–44 Schuppenreihen um den Körper, 5 Supraciliaria.

Diagnose:

KR-Länge bis max. 80 mm, SL wenig mehr als KR.

42 (1×38)–46 Schuppenreihen um die Rumpfmitte, 6/5 bis max. 7/7 Supra- bzw. Sublabialia. 3–4 anteriore Aurikulartuberkel. Dorsalia tricarinat. Ventralia glatt. Ohrdurchmesser oft kleiner als Augdurchmesser. Dorsal dunkelbraun mit je einem hellen Dorsolateralstreifen, ventral hellgrau bis rötlich.

Beschreibung:

Habitus

Kopf und Schwanz der bis zu 160 mm lang werdenden Tiere sind deutlich vom Rumpf abgesetzt. Der Augdurchmesser ist meist größer oder gleich groß dem Ohrdurchmesser.

Pholidose

Zwischen 42 und 46 Schuppen können um die Rumpfmitte gezählt werden, wobei die Tiere mit 42 Schuppenreihen häufiger sind. Von den Labialia sind meistens 7 Supra- sowie 7 Sublabialia ausgebildet, wenngleich auch Exemplare mit je 6 oder 7 Supra- und 5 Sublabialia vorkommen. Der vordere Ohrrand ist von 3 oder 4 kleinen Spinalschuppen bestanden. Die Dorsalschuppen sind schwach dreigekielt. Vier Supraocularia und 5 Supraciliaria sind ausgebildet.

Das Rostrale wird durch die Supranasalia deutlich vom Frontonasale getrennt. Das Interparietale ist gleich groß oder nur geringfügig kleiner als die Frontoparietalia. Sowohl das 5. als auch 6. Sublabiale liegen unter dem Auge. Zwei Nuchalia begrenzen caudal die Pileuspholidose.

Färbung

Die dorsal relativ dunkelbraun gefärbten Tiere zeigen alle beiderseits je einen helleren Dorsolateralstreifen. Dazwischen kann eine dunkle Fleckung, teilweise mit hellen Punkten versehen, auftreten, die auf den Flanken bei allen Exemplaren vorkommen. Die Bauchseite ist hellgrau gefärbt und bei einigen Exemplaren (♂♂) mit rötlichen Ventrolateralstreifen gezeichnet.

Maßtabelle

Mabuya stangeri stangeri von S. VICENTE

Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	OL/UL	n Schuppen
159.81.5	–	72,0	–	13,0	10,0	2,1	2,3	5,5	6/6	44
159.81.4	155,0	75,0	80,0	13,8	11,1	2,1	3,1	5,5	6/6	46
159.81.3	92,0	36,0	56,0	8,5	5,0	1,2	1,8	3,0	6/6	42
159.81.2	–	56,0	–	13,0	8,5	2,5	2,3	4,8	–	–
159.81.1	130,0	52,5	77,5	10,9	7,1	1,8	2,2	4,5	–	–
		von St. LUZIA								
2.82.9	138,0	62,0	76,0	12,5	8,0	1,9	2,9	5,0	6/5	44
2.82.8	76,0	34,0	42,0	9,2	5,2	1,5	1,8	3,2	7/6	42
2.82.7	118,0	54,0	64,0	0,0	0,0	0,0	0,0	0,0	7/5	44
2.82.6	117,0	44,0	73,0	9,1	5,5	1,3	2,5	3,7	7/6	42
2.82.5	117,0	43,0	74,0	9,0	6,0	1,5	2,0	3,5	6/5	42
2.82.4	–	51,0	–	10,0	6,5	1,5	2,6	4,1	7/5	44
2.82.3	116,0	63,0	53,0	12,2	8,5	2,0	2,8	4,9	6/5	42
2.82.2	130,0	57,0	73,0	12,0	8,1	1,8	2,1	4,1	7/6	44
2.82.1	–	63,0	–	12,9	9,4	1,8	2,1	5,0	7/6	42
		von BRANCO								
15.82.3	–	74,0	–	14,5	9,0	3,0	3,2	5,0	7/6	38
15.82.2	84,0	37,0	47,0	0,0	0,0	0,0	0,0	0,0	–	–
15.82.1	–	80,0	–	0,0	0,0	3,0	3,5	5,5	7/7	44
		von ? BRANCO								
14.82.1	150,0	67,0	83,0	12,5	10,0	2,2	2,7	5,3	7/6	44
14.82.2	–	74,0	–	14,1	10,7	2,8	3,1	6,0	7/6	44

		von RAZO								
3.82.14	133,0	65,0	68,0	13,0	8,0	2,0	2,4	5,0	7/6	42
3.82.13	143,0	66,0	77,0	13,0	8,2	2,2	2,7	5,2	7/6	42
3.82.12	–	75,0	–	14,0	9,8	1,7	3,0	5,8	7/7	42
3.82.11	–	72,0	–	14,0	9,0	2,6	2,8	4,5	6/6	–
3.82.10	154,0	71,0	83,0	13,1	9,2	2,0	2,3	5,3	7/6	42
3.82.9	–	68,0	–	13,0	9,5	2,5	2,8	5,3	7/7	42
3.82.8	–	74,0	–	13,9	10,1	2,5	2,5	5,9	7/7	42
3.82.7	151,0	68,0	83,0	12,8	10,2	2,3	2,9	5,5	7/7	42
3.82.6	–	65,0	–	13,0	9,0	2,8	2,5	5,3	7/7	44
3.82.5	154,0	75,0	79,0	14,0	10,0	3,0	3,0	5,3	7/7	44
3.82.4	151,0	67,0	84,0	12,8	9,0	2,5	2,9	5,3	7/7	42
3.82.3	156,0	71,0	85,0	13,0	10,0	2,0	2,8	5,5	7/7	44
3.82.2	140,0	63,0	77,0	12,2	8,2	2,0	2,3	5,0	7/7	46
3.82.1	–	76,0	–	13,4	10,0	2,0	2,7	5,8	7/7	44

4.1.3.2 *Mabuya stangeri maioensis* Mertens, 1955 (Taf. I, Fig. 5)

Material: 30 Ex. ZSM 160/1981; Maio. 1 Ex. ZSM 10/1982; Pt.-Cais-Maio.

1955 *Mabuya stangeri maioensis* MERTENS
1982 *Mabuya stangeri maioensis.* – SCHLEICH

31 semiadulte bis adulte Exemplare liegen von Maio vor. Während 30 Individuen aus dem Gebiet ca. 10–20 km nördlich von Vila do Maio gefangen wurden, stammt ein juveniles Exemplar (ZSM 10/1982) von der Fischerstation Pt. Cais im Norden der Insel.

Terra typica: Maio
Bisherige Verbreitung: Maio
Nachgewiesen von: Maio

Artcharakteristika nach:

MERTENS (1955) –

,,Sehr nahestehend der spinalis-Rasse von Fogo, aber die Längsstreifen, auch der dunkle Vertebralstreifen, verlöschen bzw. werden durch dunkle, in Längsreihen stehende Fleckchen ersetzt."

Anmerkung: Die Artbeschreibung von MERTENS geschah nur nach einem einzigen Exemplar. Eine Diagnose und Beschreibung wird nachfolgend gegeben.

Diagnose:

KR-Länge bis 80 mm, SL ca. 1,2× KR. 36–40 Schuppen um die Rumpfmitte. Dorsalia schwach tricarinat, Ventralia glatt. 4–5 vordere Ohrrandtuberkel. Dorsal graubraune Färbung dominierend; helle Oberschenkelocellen.

Beschreibung:

Habitus

Der Gesamthabitus der Skinke ist von rundlichem Körper mit wenig bis nicht abgesetztem Kopf- und Schwanzansatz. KR-Länge bis 80 mm, SL oft über 1,5× KR-Länge. Augdurchmesser nur geringfügig kleiner oder größer als Ohrdurchmesser. Der Schwanz ist rundlich viereckig, der Kopf kurz und gedrungen.

Pholidose

36–40 Schuppen können um die Rumpfmitte gezählt werden. Sechs bis acht, meist jedoch sieben Supralabialia sowie sechs bis sieben, meist jedoch ebenfalls sieben Sublabialia sind ausgebildet. Zwischen vier bis fünf, meist jedoch vier Spinalschuppen liegen am vorderen Ohrrand.

Eine große Palpebralscheibe bedeckt das Augenlid. Das Rostrale stößt mit den Supranasalia und dem Frontonasale zusammen. Die beiden Frontoparietalia sind geringfügig größer als das Interparietale.

Zwei Nuchalia begrenzen caudal die Schädelpholidose. Die Dorsalia sind schwach dreigekielt, die Ventralia glatt.

Färbung

Während ein Drittel der Maio-Aufsammlung aus dorsal mehr oder weniger einfarbig graubraun gefärbten Tieren besteht, scheint der Rest aus „Intergrades“ aller auf den Kapverden vorkommenden Arten zu bestehen. Die abgebildeten Zeichnungsmuster liegen innerhalb des Bereiches der auf Maio vorkommenden Typen. Wie bei *Mabuya stangeri spinalis* sind auch hier helle Oberschenkelocellen ausgebildet.

Eine typische Juvenilfärbung ist nicht zu erkennen, wenngleich auch die Mehrzahl der gefleckten bzw. mit Streifen gemusterten Tiere kleinere Exemplare sind. Die Dunkelfärbung des Rückens reicht auf Flankenhöhe ziemlich genau bis auf die Höhe der Beinoberseite bzw. des Beinansatzes. Alle Exemplare tragen auf der Caudalseite der Oberschenkel zwei bis drei, meist kreisrunde, helle Flecken. In Abbildung 6 a–d ist die Variabilität der Zeichnungsvariationen von *Mabuya stangeri maioensis* dargestellt.

Anmerkung: Für Maio, bislang geologisch als älteste der kapverdischen Inseln betrachtet, läge nun der Gedanke nahe, an eine Entwicklung oder Erstbesiedlung dieser Insel zu glauben, von wo aus radiativ die verschiedenen Nachbarinseln besiedelt worden wären. Ein Vergleich aller typischen Zeichnungsmuster verwandter Arten könnte diese Ansicht stützen.

Maßtabelle

Mabuya stangeri maioensis von MAIO

Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	OL/UL	n Schuppen
160.81.30	96,0	43,0	53,0	9,5	5,8	1,6	2,1	4,0	7/7	40
160.81.29	–	37,0	–	9,6	7,1	1,8	2,7	3,5	7/7	36
160.81.28	–	45,0	85,0	10,3	6,8	2,0	2,5	4,0	8/7	36
160.81.27	–	52,0	74,0	11,0	6,6	2,0	2,2	5,0	7/7	36
160.81.26	–	43,0	84,0	12,0	5,4	2,1	2,2	3,3	7/7	38
160.81.25	–	51,0	79,0	12,0	6,5	2,0	2,5	4,5	7/7	38
160.81.24	–	59,0	–	15,0	7,5	2,2	2,2	5,5	7/7	38
160.81.23	–	56,0	–	12,0	8,1	2,3	2,9	5,0	8/7	36
160.81.22	154,0	56,0	98,0	12,0	7,5	2,0	2,4	4,7	8/7	36
160.81.21	–	74,0	–	13,2	9,8	2,5	3,1	6,0	7/7	36
160.81.20	153,0	56,0	97,0	11,5	8,0	1,8	2,4	4,6	7/7	36
160.81.19	–	71,0	–	13,5	8,7	2,4	2,2	6,0	6/6	36
160.81.18	166,0	68,0	98,0	13,0	8,0	2,0	2,5	6,0	7/7	40
160.81.17	–	75,0	–	13,7	9,0	2,1	2,5	6,0	7/7	40
160.81.16	–	75,0	–	14,0	8,8	1,9	2,5	5,9	7/7	38
160.81.15	–	77,0	–	14,8	9,0	2,2	2,2	6,5	7/7	36
160.81.14	130,0	75,0	55,0	14,1	10,1	2,9	2,8	6,0	7/6	38
160.81.13	–	80,0	–	15,0	9,8	3,3	3,0	6,0	7/6	38
160.81.12	–	65,0	–	12,2	9,0	2,4	2,6	5,0	7/6	38
160.81.11	–	76,0	–	12,5	9,3	2,4	2,6	5,2	7/7	36
160.81.10	–	71,0	–	13,8	10,0	2,5	2,6	6,0	7/7	38
160.81.9	–	67,0	–	12,1	8,9	2,0	2,5	5,5	7/7	38
160.81.8	–	75,0	–	13,5	9,5	2,3	2,5	6,3	8/7	36
160.81.7	–	71,0	–	13,9	9,1	2,6	2,1	6,0	7/7	38
160.81.6	–	76,0	–	14,5	10,0	2,6	2,8	6,0	7/7	38
160.81.5	175,0	80,0	95,0	13,5	9,5	3,1	2,8	6,1	7/7	38
160.81.4	–	53,0	–	11,1	6,5	2,3	2,7	5,0	7/7	38

160.81.3	–	75,0	–	14,0	9,8	2,5	2,7	6,0	7/7	40
160.81.2	–	77,0	–	13,5	8,5	2,3	2,6	6,1	7/6	38
160.81.1	–	74,0	–	14,0	10,7	2,7	2,3	5,7	8/7	38

4.1.3.3 *Mabuya stangeri salensis* Angel, 1935 (Taf. I, Fig. 4)

Material: 8 Exemplare, ZSM 4/1982; Sal. 1 Exemplar, ZSM 16/1982; Sal. 1 Exemplar, ZSM 374/1978; Boa Vista.

1935 *Mabuya salensis* ANGEL
1937 *Mabuya salensis.* – ANGEL
1951 *Mabuya stangeri.* – DEKEYSER & VILLIERS
1955 *Mabuya stangeri salensis.* – MERTENS
1982 *Mabuya stangeri salensis.* – SCHLEICH

Terra typica: Sal
Bisherige Verbreitung: Sal, (?) Boa Vista
Nachgewiesen von: Sal, Boa Vista

Artcharakteristika nach:

ANGEL (1935) –

Schnauze kurz, längengleich zu dem Abstand zwischen Augenhinterrand und Ohröffnung. Nasenlöcher auf der Naht zwischen Rostrale und dem ersten oberen Labiale. Oberes Augenlid mit einer durchsichtigen Scheibe, ungeteilt. Ein Postnasale. Vorderes „Frenale" nicht in Kontakt mit erstem Labiale, Supranasalia posterior von Rostrale begrenzt. Frontonasale viel breiter als lang, in Kontakt mit Frontale. Präfrontalia ohne Mediansutur. Frontale viel länger als Frontoparietalia und Interparietale zusammen. 2. und 3. Supraokulare in Kontakt mit Frontale. 4 Supraokularia nach Größen geordnet: 2.3.4. und 1.

Drei Supraciliaria, das erste gleich lang wie die beiden verbleibenden. Frontoparietalia größer als das Interparietale. Parietalia mit einer kurzen Sutur an die nachfolgenden Schuppen. Ein Paar Nuchalia. Sieben obere Labialia, das 5. und 6. unter dem Auge, kaum verkleinert; Ohröffnung groß, oval, ihr Vertikaldurchmesser gleich lang wie der Augendurchmesser, mit davorliegenden, etwas vergrößerten Schuppen.

Dorsal- und Nackenschuppen unterschiedlich, dreigekielt. 39–40 Schuppen um die Körpermitte. Glatte Fingerlamellen. Schwanz ca. 1,2 mal der KR-Länge. 3 Supraciliaria, 5. und 6. Labiale unter dem Auge.

Maße:

GL:	124 mm	Vordergliedmaßen:	16 mm
KL:	12 mm	Hintergliedmaßen:	22 mm
KB:	8 mm	SL:	67 mm
KR:	45 mm		

Färbung:

Dunkelgrau mit Spuren einer Rückenlinie, irregulär mit hellen, dorsolateralen Schuppen.
Reihen weißer Tupfen auf den Flanken, die ebenfalls Anzeichen zu zwei Längsreihen bilden.

Anmerkung:

Nach einem Vergleich mit „*Mabuya spinalis*" gibt ANGEL (1937) für *Mabuya stangeri salensis* folgende Unterscheidungsmerkmale an: 32–40 Schuppen um die Körpermitte, 5–6 Labiale unter dem Auge, 3 Supraciliaria, vorderes „Frenale" nicht in Kontakt mit 1. Labiale, Präfrontalia ohne Mediansutur, kürzerer Schwanz, unterschiedliche Färbung.

MERTENS (1955) –

KR: 90 mm; SL: 119 mm; Sal.

MERTENS betrachtete seine Exemplare von Sal als Topotypen. Praefrontalia bilden untereinander eine Naht. 1. Supralabiale steht mit vorderem Loreale (1 Ausnahme) in Kontakt; ferner 4 (1 Ausnahme mit drei) Supraciliaria ausgebildet. 39–(40)42 Schuppenreihen, Schuppen dreikielig (bei Juvenilen zweikielig!).

Diagnose:

KR-Länge bis ca. 90 mm, Gesamtlänge bis ca. 210 mm. 36–44 Schuppenreihen um die Körpermitte; zweigekielt, selten dreigekielt. 6–7 Supra-/Sublabialia. 3–6 anteriore Aurikulartuberkel. Dunkler Dorsomedianstreifen, helle Oberschenkelocellen.

Beschreibung:

Habitus

Nach *Mabuya vaillanti* ist dies die zweitgrößte und auch kräftigste Mabuyenart der Kapverden. Bis 87 mm KR-Länge und 210 mm Gesamtlänge maß das größte, im Frühjahr 1981 gefangene Exemplar von Sal. Der Schwanz mißt nie über anderthalbmal die KR-Länge. Der Kopf ist deutlicher als bei *Mabuya vaillanti* vom Rumpf abgesetzt. Der kreisrunde Schwanz verschmälert sich ab Rumpfbasis deutlich. Der Augdurchmesser ist deutlich größer als der Ohrdurchmesser. Meist 7 (6) Supra- und 7 (6) Sublabialia sind ausgebildet.

Pholidose

Zwischen 36 und 42 (?44) Schuppen zählt man bei den Tieren von Sal um die Körpermitte, bei den Exemplaren von Boa Vista 40. Die Rückenschuppen sind schwach zweigekielt, selten dreigekielt. Das Exemplar von Boa Vista hat 7 Supra- und 6 Sublabialia, ebenso ein Exemplar von Sal, wo auch ein weiteres mit je 6 Lippenschildern vorkam. Eine deutlich erkennbare, große Palpebralschuppe ist ausgebildet. Drei bis sechs (meist 5) gut sichtbare vordere Ohrrandtuberkel sind vorhanden. Sowohl das 5. als auch 6. Supralabiale kommen unter dem Auge zu liegen.

Die Supranasalnaht zwischen Rostrale und Frontonasale ist sehr kurz. Das Nasale wird vom Rostrale und 1. Supralabiale begrenzt. 4 Supraokularia und 4–5 Supraciliaria sind ausgebildet. Die Frontoparietalia sind geringfügig größer als das Interparietale. Ein Foramen parietale ist nicht erkennbar. Zwei Nuchalia begrenzen caudal die Schädelpholidose.

Färbung

Das typische Zeichnungsmuster der meist hell- bis gelbbraun gefärbten Tiere ist ein dorsomedianer, schmaler, dunkler Streifen, der von hellen Längsstreifen begrenzt oder nur als Fleckenlinie auf einem hellen Mittelstreifen liegt. Daran folgt beiderseits ein dunkelfleckiger Längsstreifen, der wieder von zwei schmalen, hellen Dorso-Lateralstreifen gesäumt wird. Den Übergang zu den Flanken bilden meist ein bis zwei hellgetüpfelte Punktreihen. Die Bauchfärbung der Tiere ist hell-weißlich. Auf der Hinterseite der Oberschenkel sind, wie für *spinalis* und *maioensis* ebenfalls typisch, helle Ocellen ausgebildet.

Maßtabelle

Mabuya stangeri salensis von SAL

Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	OL/UL	n Schuppen
4.82.8	–	86,0	–	16,0	12,0	3,0	3,5	6,5	7/7	42
4.82.7	98,0	38,0	60,0	9,5	5,2	1,8	2,3	3,2	7/7	–
4.82.6	–	72,0	–	13,9	8,5	2,5	2,9	5,2	7/7	38
4.82.5	153,0	65,0	88,0	13,0	9,0	2,3	3,0	4,5	7/7	36
4.82.4	166,0	70,0	96,0	13,0	10,5	3,0	3,7	4,5	7/7	40
4.82.3	210,0	87,0	123,0	14,9	11,0	3,1	4,0	6,0	7/7	42
4.82.2	–	64,0	–	13,0	8,7	2,4	3,0	4,9	6/6	38
4.82.1	–	86,0	–	15,0	10,0	2,3	3,2	5,5	7/6	40
16.82.1	88,0	31,0	57,0	8,5	4,8	–	–	–	–	–
16.82.2	90,0	–	–	–	–	–	–	–	–	–
16.82.3	95,0	–	–	–	–	–	–	–	–	–

von BOA VISTA

Mabuya stangeri salensis vel *M. st. stangeri (= M. st. salensis)*

Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	OL/UL	n Schuppen
ZSM 3 74/78	176,0	66,0	110,0	13,0	9,5	2,5	2,7	5,0	7/6	40

4.1.3.4 *Mabuya stangeri spinalis* Boulenger, 1906 (Taf. I, Fig. 3)

Material: 9 Ex. ZSM 30/82; (1× intermed. mit *Mabuya vaillanti);* Insel St. Maria. 1 Ex. ZSM 6/82; Praia – S. Thiago. 3 Ex. ZSM 363/78; Tarrafal – S. Thiago. 1 Ex. ZSM 364/78; (intermed. mit *M. vaillanti;* Tarrafal – S. Thiago). 2 Ex. ZSM 156/81; 5 km S. Tarrafal – S. Thiago. 2 Ex. ZSM 368/78; Fogo. 1 Ex. BMNH 1906.3.30.40; Fogo.

1906 *Mabuya spinalis* Boulenger
1935 *Mabuya spinalis.* – Angel
1937 *Mabuya spinalis.* – Angel
1955 *Mabuya stangeri spinalis.* – Mertens
1982 *Mabuya stangeri spinalis.* – Schleich

Terra typica: Igreja und S. Filipe, Fogo
Bisherige Verbreitung: Fogo, Sal
Nachgewiesen von: Praia, Tarrafal, S. Thiago; Ilhéu St. Maria; Fogo

Artcharakteristika nach:

Boulenger (1906) – Übersetzung

Schwanz kurz, stumpf. Unteres Augenlid mit ungeteilter, transparenter Scheibe. Nasenlöcher hinter der Vertikalen der Sutur zwischen Rostrale und 1. Labiale; 1 Postnasale; vorderes Loreale gewöhnlich in Kontakt mit 1. Labiale. Supranasalia in Kontakt hinter dem Rostrale. Frontonasale breiter als lang. Präfrontalia in Kontakt mit ihrem inneren Winkel, oder eine kurze Sutur bildend.

Frontalia so lang wie Frontoparietalia und Interparietalia zusammen; in Kontakt mit dem 2. und 3. oder 1., 2. und 3. Supraoculare. Vier Supraocularia, wobei das 2. am größten ist. Vier oder fünf Supraciliaria; unterschiedliche Frontoparietalia, größer als das Interparietale. Parietalia bilden eine Sutur hinter dem letzten Schild; ein Paar Nuchalia. 5. oder 6. oberes Labiale am größten und unter dem Auge gelegen.

Ohröffnung oval; beinahe so groß wie Orbit; mit wenigen, leicht vorspringenden Granulae an der Vordergrenze. Nuchale und Nackenschuppen streng dreigekielt (tricarinat). 36 oder 38 ungleiche Schuppen um die Körpermitte. Die Hinterextremität reicht bis zum Handgelenk oder dem Ellbogen der abgespreizten Vorderextremität. Glatte Subdigitallamellen. Schwanz etwa 1,5 mal so lang wie KR. Dorsal oliv, mit oder ohne kleine schwarze Flecken; eine mehr oder weniger differenzierbare schwarze Vertebrallinie und ein blasser Streifen auf jeder Rückenseite vom Supraciliarrand bis zur Schwanzbasis. Unter diesem hellen Streifen ein dunkler oder schwarzer Streifen, der wieder von einem helleren unteren begrenzt wird; Nacken und manchmal Körperseiten mit kleinen weißen Flecken; weiße Flecken auf der Hinterseite der Schenkel; unterer Teil gelblich-weiß.

GL	146 mm		
Kopflänge	13 mm	Vorderextremität	18 mm
Kopfbreite	9 mm	Hinterextremität	26 mm
KR	46 mm	Schwanz	86 mm

Verbreitung: Igreja und S. Filipe, Fogo

Artverwandt mit *M. stangeri,* aber leicht unterscheidbar durch das Vorhandensein eines einzigen echten Suboculare, der geringeren Anzahl von Körperschuppen um die Rumpfmitte und dem Vorhandensein einer dunklen Vertebrallinie.

Mertens (1955) – 1 Exemplar von Fogo:

Interparietale vollständig entwickelt, 3 (statt 4–5) Supraciliaria. Unter dem Auge befindet sich 6. Supralabiale, das größer aber niedriger als das 7. ist. Um den Körper stehen 36 (36–38 bei den Cotypen) Schuppenreihen, dreikielig; dunkle, hellgesäumte Vertebrallinie ist vorhanden.

Angel (1937) –

Nur 1 Labiale (5. oder 6.) unter dem Auge. 4 oder 5 Supraciliaria; eine weiße Dorsolateral-Linie.

Diagnose:

KR-Länge bis ca. 70 mm bei ca. 180 mm Gesamtlänge. 34–38 Schuppenreihen um die Körpermitte; 8–6 Supra- und 5–7 Sublabialia; Dorsalia tricarinat, Ventralia glatt. 4–6 anteriore Aurikulartuberkel; 4 Supraciliaria, -ocularia. 2 Schenkelocellen auf der Rückseite der Oberschenkel, helle Tüpfelung zwischen Ohr und Achsel.

Beschreibung:

Vorab ist zu erwähnen, daß aus zwei verschiedenen Kollektionen, nämlich einer Aufsammlung von der Insel St. Maria vor Praia (ZSM 30/82) sowie aus einer Aufsammlung von Tarrafal (ZSM 363/78) zwei phänotypisch intermediäre Formen mit *M. vaillanti* auftraten. Beide Exemplare heben sich aufgrund ihrer Rückenzeichnung (Längsstreifen mit hell/dunklen Sattelflecken) deutlich von den übrigen Tieren ab, sind aber möglicherweise als intermediäre Formen abzugrenzen. Zudem besitzen sie die größte KR-Länge dieser Serie. Das Exemplar von Tarrafal (ZSM 364/78) zeichnet sich zudem noch durch die höhere Rumpfschuppenzahl (44) in seiner Serie ebenso wie das Tier von Ilhéu St. Maria (ZSM 30/82.9) mit 40 Rumpfschuppen aus. Die Pileuspholidose entspricht wieder der von *Mabuya stangeri stangeri.*

Habitus

Die kräftig gebauten Tiere sind von relativ kurzer, gedrungener Gestalt. Der stumpfe Kopf hebt sich ebenso wie der dorsoventral abgeflachte Schwanz kaum vom Rumpf ab. Die Ohröffnung ist kleiner als bei den anderen Formen, oft nur halb so groß wie der Augdurchmesser.

Pholidose

34–38 Rumpfschuppen sind ausgebildet, zwischen 9–6 Supra- und 5–7 Sublabialia kommen vor.

Dorsal sind die Schuppen dreigekielt, ventral glatt. Vier bis sechs vordere Ohrrandschuppen, 4 Supraciliaria und 4 Supraocularia sind ausgebildet. Die übrige Schädelpholidose entspricht dem *stangeri*-Typ.

Färbung

Für alle phänotypisch reinen „*stangeri spinalis*"-Tiere ist ein einheitliches Zeichnungsmuster charakteristisch.

Am auffallendsten sind dabei die systematisch wertvollen Schenkelocellen auf der Rückseite der Oberschenkel. Meist sind zwei runde, weiße Flecken auf dem Oberschenkel, bei manchen Exemplaren ebenfalls auf dem Unterschenkel vorhanden. Ebenfalls ist eine unregelmäßige, helle Tüpfelung zwischen Ohr und Achsel typisch.

Die Tiere sind dorsal von graubrauner Grundfärbung, ventral cremefarben. Dorsolateral flankieren dünne helle Streifen, vom hinteren Augenrand ausgehend bis über die Schwanzbasis hinaus, den einfarbigen oder dunkel gesprenkelten Rücken. Ein deutlich hellerer oder gleich heller Fleckenstreifen verläuft zwischen Achsel und Oberschenkelansatz, worauf lateroventral nochmals ein dunkler Streifen folgt, der dann von der hellen Bauchfärbung abgelöst wird.

Maßtabelle

Mabuya stangeri spinalis von ILHEU ST. MARIA

Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	OL/UL	n Schuppen
30.82.9	–	72,0	–	13,4	9,0	2,8	3,6	4,9	6/6	40
30.82.8	104,0	36,0	68,0	8,9	5,2	1,7	2,5	3,7	7/6	–
30.82.7	95,0	33,5	61,5	9,0	5,1	1,5	2,1	3,7	7/6	–
30.82.6	85,0	37,5	48,5	9,8	5,1	2,1	2,9	4,0	7/6	36
30.82.5	–	40,0	–	9,5	6,2	1,9	3,3	3,2	6/5	36
30.82.4	180,0	67,0	113,0	13,6	8,9	1,9	4,0	5,2	7/5	36
30.82.3	–	61,0	–	12,5	7,5	2,0	3,9	4,5	8/5	37
30.82.2	168,0	69,0	99,0	13,5	8,0	2,1	4,0	5,0	6/5	36
30.82.1	177,0	62,5	114,5	12,2	9,0	2,5	3,6	5,4	7/5	36
		Praia Hafenstraße / S. THIAGO								
6.82.1	120,0	48,0	72,0	9,4	6,0	2,0	3,8	5,5	6/7	30

		S – Tarrafal / S. THIAGO								
363.78.3	–	60,0	–	13,5	8,5	2,5	4,0	5,0	6/5	36
363.78.2	157,0	64,0	83,0	12,6	8,2	2,5	3,0	4,8	7/6	34
363.78.1	188,0	72,0	116,0	12,5	9,5	2,4	2,5	5,0	6/6	38
364.78.	–	80,0	–	15,0	10,0	3,0	3,5	6,0	7/6	44
156.81.2	180,0	67,0	113,0	13,5	9,5	2,5	3,5	4,8	7/7	36
156.81.1	177,0	67,0	110,0	13,0	9,0	3,0	3,0	5,0	7/6	36
368.78.2	–	53,0	–	11,9	6,0	1,5	3,0	4,0	7/6	40
368.78.1	–	57,0	–	12,2	7,1	1,7	3,0	5,0	7/7	36
BMNH		FOGO								
1906.3.30.40	120,0	57,0	63,0	12,0	7,2	2,1/6	2,5	5,5	7/6	36

4.1.4 *Mabuya vaillanti* Boulenger, 1887 (Taf. I, Fig. 2)

Material: 6 Ex. ZSM 152/1981, St. Cruz – S. Thiago. 1 Ex. ZSM 364/1978, Tarrafal – S. Thiago (intermed. mit *M. stangeri spinalis;* s. dort). 3 Ex. BMNH 1946/81825, 81826; BMNH 1906/33043, Fogo.

1887 *Mabuya vaillanti* Boulenger
1937 *Mabuya vaillanti.* – Angel
1955 *Mabuya delalandii.* – Mertens
1976 *Mabuya vaillanti.* – Greer
1982 *Mabuya vaillanti.* – Schleich

Terra typica: S. Thiago
Bisherige Verbreitung: S. Thiago, Fogo, Rhombos
Nachgewiesen von: S. Thiago, Fogo (Material: BMNH)

Artcharakteristika nach:

Angel (1935) –
54 Schuppen um die Körpermitte, 5. und 6. Supralabiale verschieden, bilden Subokularia. Ohröffnung viel größer als Augöffnung.

Greer (1976) –
KR: 122 mm; 54 Schuppenreihen.

Diagnose:

KR-Länge ca. 13 cm bei ca. 29,5 cm Gesamtlänge. Kopf klein, stumpf, wenig abgesetzt. 50–56 Schuppen um die Rumpfmitte, 7 Supra- und 6 Sublabialia. 4–6 posteriore Aurikulartuberkel. 5. Supralabiale vergrößert unter Auge. Parietalia mit Interparietale verschmolzen; ein oder zwei Nuchalia; Dorsalia schwach tricarinat. Gelb-orange Schnauzenfärbung; Rückenzeichnung typisch dreistreifig.

Beschreibung:

Diese größte kapverdische Art der Gattung *Mabuya* konnte aufgrund ihrer scheuen, relativ versteckten Lebensweise erst spät, nach einem Hinweis von Herrn R. Steffens, entdeckt werden. Ihm und Frau E. Stein gebührt hier ein besonderer Dank bei der Auffindung dieser von Mertens 1955 mit *Mabuya delalandii* synonymisierten Art.

Sympatrisch mit *Mabuya delalandii* und *Mabuya stangeri spinalis* konnte *Mabuya vaillanti* bei Tarrafal (S. Thiago) beobachtet werden.

Habitus

Bis zu 295 mm Gesamtlänge bei 122 mm KR-Länge maß ein Tier von St. Cruz. Der Schwanz ist nie länger als das 1,5fache der KR-Länge. Der Körper der Tiere ist relativ breit, rundlich und Kopf wie Schwanz nur wenig vom Rumpf abgesetzt. Der Schwanz ist rundlich, relativ lang. Der Kopf ist in Relation zur Körpergröße klein und schmal. Die Ohröffnung ist größer oder nur geringfügig kleiner als der Augdurchmesser.

Pholidose

Die sechseckigen Dorsalia sind zwei- bis meist dreikielig, auf den Ventralia ist die Dreikielung nur noch angedeutet zu erkennen. Zwischen 50 und 56 Schuppenreihen zählt man um die Rumpfmitte. Der Pileus zeigt eine deutliche, nur für *vaillanti* spezifische Pholidose. Das breite Rostrale reicht bis unter die Nasalia. Zwei Supranasalia schließen sich an. Das folgende Frontonasale ist von gleicher Breite wie die beiden Supranasalia zusammen. Zwei Präfrontalia, 1 Frontale sowie 4 Supraocularschilder begrenzen seitlich und von vorne das ungeteilte Frontoparietale. Ein großes ungeteiltes Parietale reicht beidseits fast bis an die hinteren Ciliaria. Ein großes Nuchale von fast der Breite des Frontoparietale grenzt die Pileusschuppen von den Dorsalia ab. Eine typische Palpebralscheibe ist ausgebildet.

Zwei Postocularia und zwei Postsubocularia sind erkennbar. Neun Temporalia liegen zwischen dem Postoculare und den Aurikulartuberkeln. Meist sind 7 Supra- und 6 Sublabialia zu zählen, zwei Postlabialia begrenzen Oberlippen und Ohr. Die ventrale Kopfbeschuppung besteht aus einem umfassenden, bis unter die Mitte des 1. Supralabiale reichenden Mentale, einem bis unter die Mitte des 2. Sublabiale reichenden Postmentale sowie je Seite 3 Submaxillaria, deren 1. und 2. ein Inframaxillare flankieren.

Färbung

Von der graubraunen bis kräftig braunen Grundfärbung heben sich auf dem Rücken drei hellbraune Streifen ab. Die Seitenstreifen sind etwa anderthalbmal bis doppelt so breit wie der Mittelstreifen und beginnen kurz oberhalb und hinter dem Ohr, um dann nach etwas mehr als der Hälfte der Schwanzlänge wieder zusammenzulaufen. Der dünnere Mittelstreifen dagegen beginnt erst ab Achselhöhe. Die gesamte Schnauzenspitze bis etwa zum 2. Labiale inklusive des Mentalbereiches ist kräftig orange gefärbt. Die dazwischen liegenden dunkleren Streifen werden von noch dunkleren braunen Punkten im Abstand von ca. 0,5 mm eingefaßt. Ab dem hinteren Ohrrand hebt sich ein schwarz/gelber Fleck ab, dessen Farbgrenze ziemlich genau auf der Mitte des Ohres liegt. Entlang der Flanken zieht eine Punktreihe weißer Flecken. Darunter wechselt die Flankenfärbung nach grau mit schwarzen Sprenkeln, die sich über die Ventralseite fortsetzen können. Die Hand- bzw. Fußsohlen sind ebenso wie Schnauze und Kehle orange gefärbt. Bei ♂♂ tritt diese Färbung auch auf dem Bauch auf. Bemerkenswert ist das Zeichnungsmuster noch zwischen Kehl- und Achsel-Bereich. Ab dem posterioren Ende der orangen Kehlfärbung verlaufen beidseits je drei Streifen zum Ohr, zwei etwa auf halber Länge Ohr/Achsel und der dritte bis kurz vor der Achsel. Die Vorder- wie Hinterextremitäten können ebenfalls gesprenkelt erscheinen. Schwach bis deutlich erkennbare schwarz/(gelbe) Achselocellen können auftreten.

Maßtabelle

Mabuya vaillanti von St. Cruz / S. THIAGO

Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	OL/UL	n Schuppen
152.81	–	130,0	–	23,0	15,0	4,0	4,5	9,5	7/6	52
152.81	295,0	122,0	173,0	21,6	14,5	4,7	4,0	9,0	7/6	54
152.81	233,0	116,0	117,0	19,2	14,5	3,8	4,2	8,0	7/6	52
152.81	–	80,0	–	16,0	10,5	3,5	3,1	6,0	7/6	54
152.81	151,0	71,0	80,0	13,5	9,0	3,1	2,9	5,8	7/6	50
152.81	281,0	110,0	171,0	21,6	15,5	4,1	4,2	9,0	7/6	54
	Trockenexemplar			21,2	17,0	5,2	3,8	8,6	7/6	52
BMNH										
1946.81825	250,0	117,0	133,0	20,5	17,0	4,5	4,7	8,5	7/6	50
1946.81826	235,0	100,0	135,0	18,0	14,0	4,0	3,9	7,5	7/6	50
	von FOGO									
1906.33043	203,0	99,0	104,0	18,7	13,7	3,4	4,0	7,1	7/6	56

4.2 Gekkonidae – Genus *Tarentola*

Während DUMERIL & BIBRON (1836) *Platydactylus (= Tarentola) delalandii* als Form mit einfachen, ovalen, nur sehr schwach gekielten Dorsaltuberkeln mit einem Ohrloch ohne zackige Randschuppen und einer Schuppenreihenzahl von 6 auf dem Schwanz als Tiere von Tenerife darstellen, beschreibt STEINDACHNER (1891) *Tarentola delalandi boettgeri* als eine Form mit den gleichen Merkmalen, die er durch die höhere Anzahl von 16–18 Tuberkelreihen von Tieren von Gran Canaria und jenen mit 12–14 Reihen von Tenerife, Palma und Gomera unterscheidet. Hinzu kommt, daß DUMERIL & BIBRON keine Angaben über die Anzahl der Tuberkelreihen gemacht hatten, ihre Beschreibung aber gänzlich der Art *boettgeri* sensu STEINDACHNER, entsprechen würde. Nach Materialvergleichen mit Aufsammlungen sowohl von den Canaren als auch den Kapverden und all den verwirrenden Beschreibungen nachfolgender Autoren wäre fast an eine Fundortverwechselung von DUMERIL & BIBRON zu denken. Verwirrender wird letztlich noch die Synonymisierung von LOVERIDGE (1947, S. 5, 6) mit folgender Erklärung: ,,As a further consequence of these studies nearly fifty described forms or species appear to be unrecognizable . . . The following, however, are believed to be referred to the synonymy for the first time:

,,*Tarentola gigantea* (lapsus) Scherer = *T. delalandii gigas* (Bocage)
Tarentola d. var. *boettgeri* Steindachner = *T. d. delalandii* Dumeril & Bibron
Tarentola d. var. *boettgeri* Boulenger = *T. d. delalandii* Dumeril & Bibron.“

MERTENS (1955, S. 6) stellte sämtliche kapverdischen Tarentolas (außer den Tieren von Branco und Razo) zu *Tarentola delalandii rudis,* ,,weil das vorliegende Material trotz seiner Variabilität in seiner Gesamtheit einen anderen Eindruck macht, als die auf den Kanaren lebenden Angehörigen von *Tarentola delalandii*“, und sieht sowohl *Tarentola delalandii delalandii* (von Tenerife) und *delalandii boettgeri* von Gran Canaria als lediglich auf den Kanaren verbreitete Rassen an. Bei den Tieren von Fogo erwähnt er nur ein durch seine Größe von der übrigen Aufsammlung herausfallendes Exemplar, sieht dieses jedoch wiederum innerhalb der Variabilität dieses Rassenkreises an:

T. delalandii: Schnauze ein wenig länger als die Entfernung zwischen Auge- und Ohröffnung. Das Mentale ist in der Mitte nicht länger als seine dreifache Breite.

T. gigas: Schnauze nicht viel länger als der Aug/Ohr-Abstand. Die Kinnschuppenlänge entspricht ihrer dreifachen Breite.

Während er für *T. delalandii* die ,,Varietäten“ wie folgt abgrenzt:

T. del. delalandii: 12 Längsreihen vergrößerter Tuberkel, glatt oder gekielt.

T. del. rudis: 16–18 Tuberkelreihen, deutlich gekielt, 4 Transversalbänder mit hellen Mittelflecken, Schwanzschuppen spinös.

T. del boettgeri: 18–20 glatte Tuberkelreihen, gerade Transversalbänder.

JOGER (1984) trägt nun, nach meinem Versuch (SCHLEICH 1984) die Systematik der kapverdischen Tarentolas zu er- und überarbeiten, erneut zu größerer, hauptsächlich nomenklatorisch taxonomischer Verwirrung bei, indem er längst ,,verschollene“ nomina oblita zu revalidisieren versucht.

Eine Klärung dieser neu entstandenen Problematik ergibt sich jedoch zwangsläufig aus der Beachtung der Internationalen Regeln für die Zoologische Nomenklatur, insbesondere mit ihren 1970 erfolgten Ergänzungen, so daß die alteingeführten nomina conservanda von *Tarentola gigas* und *Tarentola rudis* selbstredend erhalten bleiben können. Hierfür einige Auszüge aus besagten Ergänzungen:

(Erklärung 43 n. Fassung v. 1. I. 1970 zu § 23b I–VIII)

§ 33b I: ,,Einschränkung. – Ein Name, der sich in fortlaufendem, allgemeinen Gebrauch befindet und mindestens 50 Jahre verfügbar gewesen ist, darf nach 1960 nicht durch ein unbenutztes älteres Synonym ersetzt werden.“

,,Ein Name ist als in fortlaufenden allgemeinem Gebrauch befindlich anzusehen, wenn er in den unmittelbar vorausgehenden 50 Jahren von mindestens fünf verschiedenen Autoren und in mindestens zehn Veröffentlichungen als mutmaßlich gültiger Name auf ein bestimmtes Taxon bezogen wurde.

(II) Ein älteres Synonym ist als unbenutzt anzusehen, wenn es im Laufe der unmittelbar vorausgehenden 50 Jahre kein einziges Mal auf ein bestimmtes Taxon als dessen mutmaßlich gültiger Name bezogen wurde. Ein älteres unbenutztes Synonym, das nach 1960 unter Verletzung der Vorschriften von Artikel 23 b verwendet wurde, sei es, um das jüngere Synonym ausdrücklich zu ersetzen oder nicht, verliert hierdurch nicht seinen Status als unbenutzter Name.

(III) Die Erwähnung eines Namens in der Synonymie oder lediglich dessen Aufnahme in eine Referier-Veröffentlichung, einen Nomenklator oder sonstigen Index oder eine Liste von Namen bedeutet keinen Gebrauch im Sinne von Artikel 23b.

(IV) Jedes Zitat ist für sich zu werten, ohne Rücksicht auf Art oder Titel der Arbeit, in welcher der Name vorkommt."

Zusammenfassen läßt sich so nach Absatz 4 der Normen der Verfügbarkeit:

Tarentola borneensis wurde 1965 von WERMUTH im Sinne von LOVERIDGE (1947: 33!) als synonym zu *Tarentola delalandii delalandii* betrachtet und wäre außerdem so nicht als für *Tarentola gigas* angewandt zu betrachten. Unabhängig davon wurde von beiden Autoren *Tarentola delalandii gigas* als eigenständig gültiges Taxon dargestellt. Außerdem tritt für den von JOGER zitierten Fall eindeutig § 23b III in Kraft. Eine gesonderte Synonymieliste zur Demonstration der Erfüllung dieser Verfügbarkeitsnormen (§ 23b I) ist im Kapitel *Tarentola gigas* aufgeführt. Die Forderung von § 23b sind alle rechtmäßig erfüllt, die Zoologische Nomanklaturkommission wurde dazu von mir, folgend § 23b V, informiert.

Bestehen bleibt, daß sich sowohl nach morphologischen als auch nach Pholidose- und Zeichnungsmerkmalen folgende 4 Artengruppen von *Tarentola* als eigenständige Formenkreise ausgliedern lassen:

Tarentola rudis, eine durch besonderes Größenwachstum gezeichnete Art, wird von den Inseln Fogo, S. Thiago mit St. Maria und Maio beschrieben. Sie kommt auf S. Thiago neben einer ,,samtschuppigen" Form, mittlerweile als *Tarentola darwini* beschrieben, vor. Das sympatrische Vorkommen dieser beiden phänologisch eindeutig unterscheidbaren Arten zieht taxonomische und nomenklatorische Schlußfolgerungen nach sich. Dementsprechend wird neben *Tarentola darwini Tarentola rudis* als eigenständige Kapverden-Art betrachtet, deren verschieden phänotypisch-morphologische Ausbildungen der unterschiedlichen Inselformen, Rassenkreise unter den Kapverden-Inseln abzugrenzen zwingt. Daneben konnte *Tarentola caboverdiana* Schleich 1984 mit diversen Unterarten ausgegliedert werden.

Die Riesengeckos der beiden Inseln Branco und Razo werden wiederum als eigene Formen der Art *gigas* betrachtet.

Entgegen meiner Darstellung (SCHLEICH, 1982 a) in der Tabelle 1 zu ,,Vorläufige Mitteilungen zur Herpetofauna der Kapverden" mit *Tarentola delalandii delalandii* als ,,Hauptform" der kapverdischen ,,Mauer"geckos und *rudis* als Rassenkreis davon, bleibt die von DUMERIL & BIBRON (1836) beschriebene ,,*Platydactylus*" *delalandii* für Tenerife, Madeira und Senegal bestehen.

Tarentola delalandii rudis Boulenger wurde 1906 mit der Terra typica-Angabe: S. Filipe auf Fogo sowie Praia von S. Thiago bekannt und war so neben den Riesengeckos die einzige von Caboverde beschriebene Tarentola.

Daraus ergab sich für ,,*rudis*" die Notwendigkeit, jene Form als kapverden-typisch anzusprechen, während die Unterarten *Tarentola delalandii boettgeri* und *Tarentola delalandii* nur im nordmakaronesischen Raum mit den Unterarten *boettgeri* und *delalandii* vertreten sind.

Zu dem von mir für *Tarentola gigas* betrachteten eigenen Artstatus stimme ich in bezug auf Größe und Morphologieaffinitäten zu *Tarentola rudis protogigas* mit JOGER's Ansicht überein, jedoch sind die Formen von Branco und Razo in ihrem Verhalten und in ihren ökologischen Ansprüchen so von allen übrigen Kapverdengeckos verschieden, daß eine Gleichheit auf Artniveau angezweifelt werden muß. Als gravierende Merkmalsunterschiede wären nach umfangreichen Gelände- und Gefangenschaftsbeobachtungen zwischen den beiden erwähnten Formen zu nennen:

Tarentola (r.) protogigas	*Tarentola gigas*
Lautäußerungen konnten nie wahrgenommen werden.	Lautäußerungen spielen im sozialen Verhaltensmuster eine deutliche Rolle (spez. epigamisch).
Eiablage ungeklärt, erfolgt den Lebensgewohnheiten nach wahrscheinlich an Mauer oder vergleichbarem Trockensubstrat.	Eiablagen erfolgen nur unter ausgesucht speziellen Bedingungen (s. SCHLEICH 1980).
Tiere bewegen sich speziell auf vertikalen Wänden.	Adulte Tiere sind kaum in der Lage, sich in der Vertikalen zu halten (zu großes Körpergewicht), und konnten als über 95% bodenständig in ihren Lebensäußerungen beobachtet werden. Eine positive Selektion zum Riesenwuchs war durch fehlende inter-/intraspezifische Competition möglich.
Eine besondere Fettspeicherung fehlt.	Eine extreme Fettspeicherung ist typisch.

4.2.1 *Tarentola rudis* Boulenger, 1906

4.2.1.1 *Tarentola rudis rudis* Boulenger 1906 (Taf. II, Fig. 3; Taf. IV, Fig. 2)

Material: 3 Ex. ZSM 139/1981 – S. Thiago / Praia-Flughafen. 1 Ex. ZSM 372/1978 – S. Thiago / C. Velha. 2 Ex. ZSM 135/1981 – S. Thiago / Praia. – Paralectotypus n. JOGER (1984: 101); MCNG 28149/2.

1906 *Tarentola delalandii* var. *rudis* BOULENGER
1935 *Tarentola delalandii*. – ANGEL
1937 *Tarentola delalandii*. – ANGEL
1947 *Tarentola d.* var. *rudis* BOULENGER
= *Tarentola d. delalandii* (DUMERIL & BIBRON). – LOVERIDGE
1955 *Tarentola delalandii del.*. – DEKEYSER & VILLIERS
1955 *Tarentola delalandii rudis*. – MERTENS
1984 *Tarentola rudis rudis*. – SCHLEICH (part.)
1984 *Tarentola b. (= borneensis) rudis*. – JOGER

Terra typica restricta: Praia – S. Thiago, ?S. Filipe-Fogo

Bisherige Verbreitung: Sal, Boa Vista, Maio, S. Thiago, Fogo, Brava, St. Luzia

Nachgewiesen von: S. Thiago (Praia), Ilhéu St. Maria (von dem kleinen Eiland St. Maria vor Praia wurden aus Schutzgründen keine Tiere gefangen)

Artcharakteristik nach:

BOULENGER (1906) –

Hervorstechende Tuberkel, mehr oder weniger unterschiedlich gekielt, auf dem Schwanz fast spinös; in 16–18 Transversalreihen auf der Körpermitte; Schläfe mit sehr unterschiedlich vergrößerten Tuberkeln; 4 verschiedene, wellige oder w-förmige dunkle Querbänder, deren mittlerer Sinus an einen hellen Fleck grenzt. KR bis 88 mm.

Diagnose:

Eine Diagnose ergibt sich nach SCHLEICH (1984) und JOGER (1984) wie folgt:

Kopf-Rumpflänge max. 8,5 cm, ♀♀ kleiner (6,5 cm). 16 Tuberkelreihen; zwischen 10/11 Supra- und 9/10 Sublabialia. 16–19 Interorbitalschuppen; 130–165 Schuppenreihen um die Körpermitte. Dorsaltuberkel undeutlich gekielt. Fünf dunkle Transversalbänder. Orbit meist doppelt so groß wie Ohrdurchmesser. Auf dem ersten Finger 12, auf dem dritten 13 Subdigitallamellen. Verhältnis Mentalialänge : -breite ca. 2:1. Maulspaltlänge um mindest die Hälfte länger als die Strecke zwischen vorderem Augenrand bis Schnauzenspitze. Entfernung Ohr–Auge geringer als Augvorderrand–Schnauzenspitze.

Beschreibung des Lectotypus: s. JOGER (1984: 101)

Anmerkung: JOGER designierte aus BOULENGER's Syntypen von „S. Jago" eines der Exemplare als Paralectotypus zu „*T. b. rudis* Boul., 1906" von S. Thiago mit der Terra typica restricta: „Dist. di Praia, Calhetta de S. Martinho". Da mir seinerzeit dieses Originalmaterial nicht zur Verfügung stand, ich selbst aber umfangreichere Aufsammlungen von Fogo, St. Maria (S. Thiago) und von Praia selbst tätigte, glaubte ich, daß die von genannten Lokalitäten gefangenen Exemplare alle einem sehr variablen Rassenkreis angehören würden. Mittlerweile möchte ich mich aber der Ansicht JOGER's anschließen und den südl. Bereich von S. Thiago als Vorkommen für *Tarentola rudis rudis* bestätigen.

Beschreibung:

Für die von mir gesammelten Exemplare von Praia ergibt sich: Kopf-Rumpflänge bis 58,5 mm, der Schwanz ist meist länger, so daß sich max. eine Gesamtlänge von 120,5 mm ergibt. Der Schädel ist deutlich länger als breit, der Augdurchmesser etwa doppelt so groß wie der Ohrdurchmesser. Der Abstand Ohr/Auge ist wenig kleiner als der Abstand Auge/Schnauzenspitze. Der Maulspalt reicht bis hinter das Auge. Das Mentale ist etwa doppelt so lang wie breit. An Lippenschildern sind 10–11 Supra- und 9–10 Sublabialia ausgebildet. Die Rückentuberkel sind in 16 Längsreihen angeordnet. Die Tiere sind grau bis graubraun gefärbt und tragen 5 Transversalbänder.

Maßtabelle

Tarentola rudis rudis von S. THIAGO;

											Mentale			Tub.	Lam.	
Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	AS	MSP	L	B	OL/UL	R.	1/3	Bd
139.81.1	115,0	58,5	56,5	17,7	14,1	1,7	4,7	7,0	8,0	12,1	5,6	2,6	10/9	16	–	5
139.81.2	116,0	56,0	60,0	18,6	12,8	2,1	4,1	7,1	7,8	12,0	5,0	2,5	10/9	16	12/13	5
139.81.3	120,5	58,5	68,0	18,0	12,5	1,8	4,0	6,5	8,0	12,8	5,0	2,5	11/10	16	–	5

4.2.1.2 *Tarentola rudis maioensis* Schleich, 1984 (Taf. II, Fig. 5; Taf. IV, Fig. 1)

Material: Holotypus – ZSM 136/81.6. Paratypen – ZSM 136/81.1–5 u. 7–9.

1954 *Tarentola delalandii rudis.* – MERTENS (part.)
1984 *Tarentola rudis maioensis.* – SCHLEICH
1984 *T. b. (borneensis) maioensis.* – JOGER

Terra typica: Maio
Verbreitung: Maio und n. JOGER (1984: 102) auch Boa Vista

Diagnose:

Gesamtlänge bis ca. 139 mm bei max. 68 mm KR-Länge. Die Kopflänge entspricht dem 1,3–1,6fachen der Kopfbreite. Der Abstand zwischen vorderem Ohrrand und Auge ist meist gleich groß der Entfernung vom Auge zur Schnauzenspitze. 12–18 Tuberkelreihen; eine Dorsalbänderung ist kaum wahrnehmbar.

Beschreibung:

Die Tiere sind von relativ plumper, kräftiger Gestalt und bis ca. 139 mm lang, ihr Kopf erscheint groß und breit. Der Maulspalt reicht deutlich hinter den Pupillenspalt, der Ohrschlitz ist auffallend klein und etwa nur halb so groß wie der Augdurchmesser. Die Tuberkelschuppen sind konisch bis leicht apikal.

Alle Tiere sind graubraun gefärbt, ohne deutliche Rückenbänderung. Falls erkennbar sind 5, relativ breite, schwach dunkle Transversalbänder mit hellem Kernfleck oder Mittelstreifen typisch. Zwischen Ohr und Auge zieht sich bis zu den Nasenlöchern ein heller Streifen.

Maßtabelle

Tarentola rudis maioensis von MAIO

											Mentale			Tub.	Lam.	
Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	AS	MSP	L	B	OL/UL	R.	1/3	Bd
136.81.1	–	64,0	–	20,0	12,8	2,5	5,0	8,2	8,5	12,0	5,9	3,5	9/7	12	11/7	–
136.81.2	–	66,5	–	21,0	16,0	2,5	5,2	9,0	9,0	13,0	5,5	3,0	8/7	14	8/7	–
136.81.3	–	65,0	–	21,0	16,0	2,1	5,0	9,0	8,5	14,0	5,0	3,2	8/7	16	11/12	5
136.81.4	–	47,0	–	15,0	10,0	1,8	4,0	7,0	7,0	11,0	4,5	2,0	8/7	14	11/11	5
136.81.5	128.5	66,0	62,5	20,0	13,5	2,5	4,0	8,9	8,2	12,5	5,2	2,5	9/7	14	14/11	5
136.81.6	139,0	68,0	71,0	22,0	16,0	2,8	5,2	8,5	8,5	11,5	5,5	2,3	9/7	18	13/13	5
136.81.7	93,0	48,0	45,0	15,5	11,5	2,0	4,0	6,0	6,5	10,0	4,5	2,0	9/8	16	12/11	5
136.81.8	–	63,0	–	18,9	14,0	2,5	4,0	8,0	8,5	11,5	5,5	2,5	9/8	14	11/12	–
136.81.9	107,0	59,5	47,5	17,2	14,0	2,1	3,9	7,0	7,6	11,0	4,9	2,1	9/8	14	11/13	5

4.2.1.3 *Tarentola rudis protogigas* Joger, 1984 (Taf. II, Fig. 1, 2, 4; Taf. IV, Fig. 7)

Material: 11 Ex., ZSM 145/1981 – Fogo. Holotypus: ZSM 145/1981.1 – Fogo. Paratypus: ZSM 145/1981.2 – Fogo und Exemplare des BMNH u. MCNG C. E. (s. JOGER, 1984: 101).

1906 *Tarentola delalandii* var. *rudis* BOULENGER (part.)
1947 *Tarentola delalandii.* – LOVERIDGE (part.)
1984 *Tarentola rudis rudis.* – SCHLEICH (part.)
1984 *Tarentola b. (borneensis) protogigas.* – JOGER

Terra typica: Fogo

Anmerkung: Ein isoliertes Vorkommen von einer allerdings recht kleinen Population konnte auf dem Inselchen St. Maria in der Hafenbucht vor Praia entdeckt werden. Die Tiere erreichten mindest die Körperlänge der Exemplare von Fogo. Aus Schutzgründen wurde hier jedoch selbst auf Belegexemplare verzichtet, da wir nur sehr wenige große Individuen zu sehen bekamen.

Verbreitung: Fogo, Ilhéu St. Maria (S. Thiago) und nach JOGER (1984: 101) Brava, Rhombos-Inseln

Diagnose:

Mit *Tarentola gigas* die größte kapverdische *Tarentola* mit morphologischer Merkmalsausbildung der *T. rudis*-Gruppe. Rückentuberkel schwach gekielt, 144–181 Schuppen um die Körpermitte. Max. KR-Länge 98,5 mm. Schwanz kürzer als Kopf-Rumpflänge. Die Anzahl der Subdigitallamellen beträgt bei der 1. Zehe 12–14 und an der 5. Zehe 22–26 bis zur Zehenbasis gezählt.

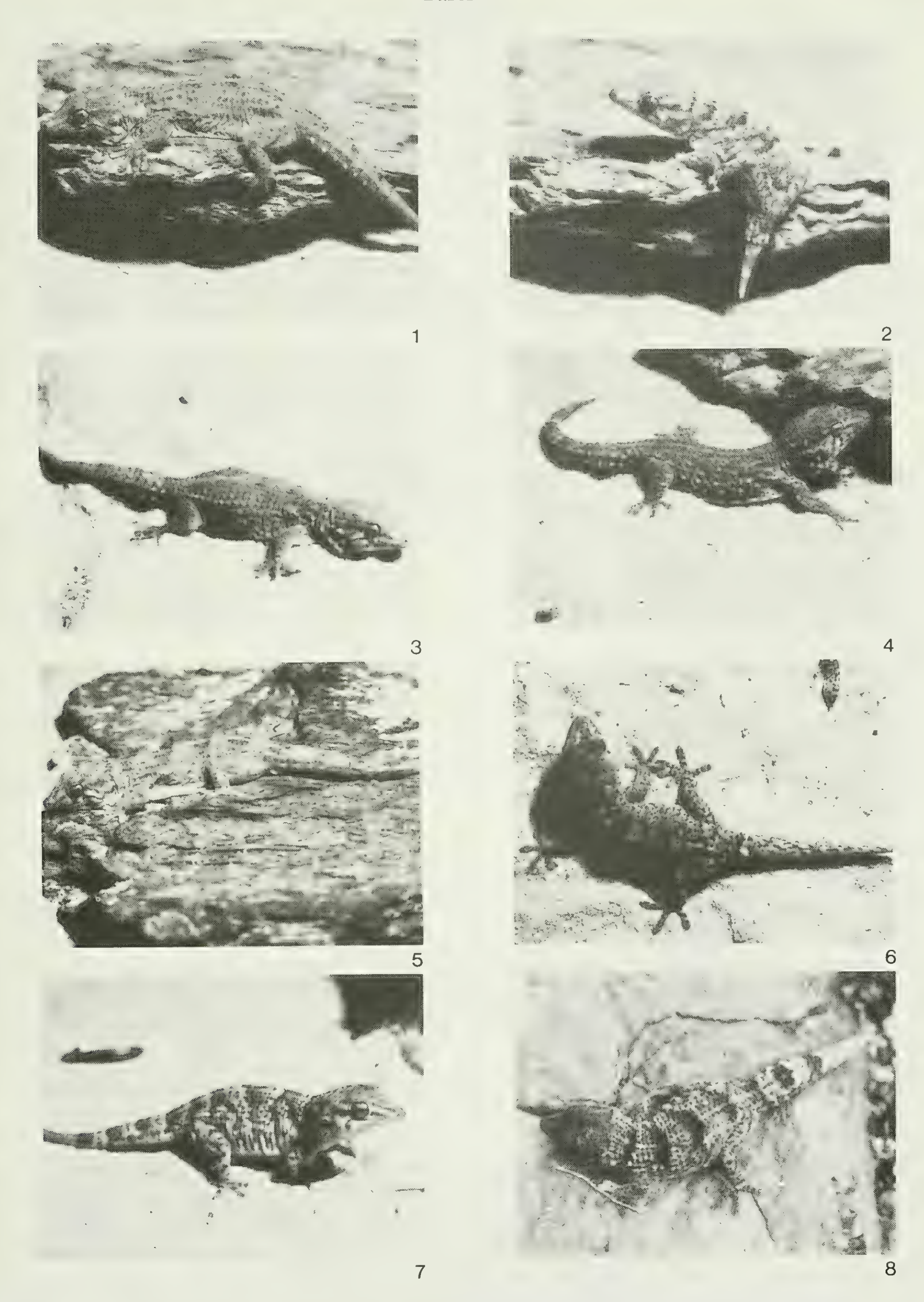
Beschreibung:

Die bis knapp 10 cm (KR) lang werdenden Tiere sind kräftig gebaut, jedoch nicht so massig und dick wie die Riesengeckos *(T. gigas)* der Inseln Branco und Razo. Auf die Kopflänge entfallen dabei etwa 1/3 bis 1/4 der KR-Länge.

Der Maulspalt reicht bis hinter das Auge. Der Ohrschlitz ist meist halb so groß wie der Augdurchmesser. Die Tuberkelschuppen sind relativ flach, leicht apikal und von entsprechend kleinen Schuppen umgeben. Die leicht vorgezogene Spitze ist nur wenig erhaben. In meist 16 Längsreihen (1 Ausnahme mit 18) sind die Rückentuberkel angeordnet. Die Mentalialänge entspricht etwa zweimal ihrer mittleren Breite. Meist sind 10–11 Supra- und 8–9 (7, 11) Sublabialia ausgebildet.

Die grau bis graubraun gefärbten Tiere tragen 4–5 Transversalbänder.

Tafel II



Tafel II: Fig. 1: *Tarentola rudis protogigas* von Fogo; adultes Exemplar, in katasematischer Färbung. Fig. 2: *Tarentola rudis* cf. *protogigas* von Fogo. Fig. 3: *Tarentola rudis rudis* von S. Thiago. Fig. 4: *Tarentola rudis* cf. *protogigas* von Ilhéu St. Maria. Fig. 5: *Tarentola rudis maioensis* von Maio. Fig. 6: *Tarentola darwini* von Tarrafal-S-Thiago. Fig. 7: *Tarentola caboverdiana substituta* von S. Vicente. Fig. 8: *Tarentola caboverdiana raziana* von St. Luzia.

Maßtabelle

Tarentola rudis protogigas von FOGO; n = 11

Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	AS	MSP	Mentale L	Mentale B	OL/UL	Tub. R.	Lam. ⅓	Bd
145.81.1	–	98,5	–	24,9	21,5	3,8	6,0	11,5	13,0	18,5	7,0	4,0	10/9	16		4
145.81.2	–	88,0	–	26,5	20,5	2,9	6,0	10,3	11,5	16,8	7,0	3,8	10/9	16		4
145.81.3	–	72,0	–	23,0	16,3	2,3	5,0	7,5	10,0	15,0	5,0	3,3	10/9	16	13/15	4
145.81.4	–	72,0	–	19,0	17,8	2,5	5,0	8,2	9,0	15,0	6,0	2,6	10/9	16		5
145.81.5	–	57,0	–	17,5	12,5	2,8	4,8	6,5	7,5	13,0	4,5	2,5	10/8	16		5
145.81.6	–	83,0	–	25,0	19,0	2,5	5,0	10,0	11,0	17,0	6,7	3,5	11/11	18		5
145.81.7	–	82,0	–	24,5	17,5	3,5	6,0	10,0	11,5	17,3	7,0	3,0	11/11	16		4
145.81.8	–	63,0	–	21,5	15,3	2,5	5,0	7,0	9,2	15,5	6,0	3,5	10/8	16		5
145.81.9	–	68,0	–	21,0	15,2	2,1	5,0	7,0	9,3	14,1	6,0	3,0	9/7	16		5
145.81.10	–	58,0	–	18,0	13,5	3,0	4,8	6,8	7,8	12,5	6,0	2,6	9/8	16		4
145.81.11	–	53,0	–	14,0	11,7	2,1	4,0	6,5	7,5	12,5	4,5	3,0	11/9	16		5

4.2.2 *Tarentola darwini* Joger, 1984 (Taf. II, Fig. 6; Taf. IV, Fig. 3)

Material: 22 Ex. Holotypus – ZFMK 37256 (coll. et don. Schleich, 1978), S. Thiago-Tarrafal, und 21 Ex. ZSM 365/78, 146/81, 147/81, 29/82, S. Thiago-Tarrafal. Paratypen (nach JOGER, 1984): 365/78, 146/1981, 147/1981.

1906 *Tarentola delalandii boettgeri* BOULENGER
1947 *Tarentola delalandii delalandii.* – LOVERIDGE
1954 *Tarentola delalandii rudis.* – MERTENS
1982 *Tarentola* sp. – SCHLEICH
1984 *Tarentola* sp. – SCHLEICH
1984 *Tarentola darwini.* – JOGER

Terra typica: Tarrafal, S. Thiago
Verbreitung: Tarrafal, S. Thiago; Igreja, Fogo
Die Vermutung JOGER's (1984) für ein Vorkommen auf Nicolau und Sal erscheint mir spekulativ, für Fogo dagegen wahrscheinlich.

Diagnose:

Eine Diagnose ergibt sich nach JOGER (1984: 96) und SCHLEICH (1984: 102):

Kopf-Rumpflänge bis 62 mm. Flache, meist glatte Tuberkel mit nur schwachem Kiel. 18–20 Tuberkelreihen.

Deutlich abgesetzte, zu Ketten verwobene Härchen der Schuppenoberflächen, die sich dadurch samtig anfühlen. Zahlreiche, meist glatte Rückentuberkel zwischen den Hinterseiten der Vorder- und Hinterbeinansätze. Dorsal enge bis unregelmäßige Transversalbänder bis marmorierter Zeichnungstyp.

Die weiteren von JOGER (op. cit.) unter „Diagnose" erwähnten Merkmale sind differentialdiagnostisch.

Beschreibung:

Für die Tiere von Tarrafal ergeben sich folgende Merkmale: Die bis 110 mm Gesamtlänge messenden Tiere sind von relativ kleinem Habitus mit auffallend kleinem Kopf. Die Kopflänge entspricht etwa 1,1- bis 1,4mal der Kopfbreite. Die Ohröffnung ist klein, meist kleiner als der halbe Augdurchmesser. Der Abstand Ohr–Auge ist nur geringfügig kleiner als der vom Auge zur Schnauzenspitze. Zwischen 8–13 Supra- sowie 7–10 Sublabialia können ausgebildet sein. An einem Exemplar konnten an der ersten Zehe 9 und an der dritten 13 Subdigitallamellen gezählt werden. Die Mentaliabreite entspricht etwa der halben Mentalialänge. Die Tuberkel sind rundlich bis oval, schwach gekielt und kaum erhaben; sie sind in 14–18 Längsreihen angeordnet. Das Mentale wird von 2 Submaxillaria flankiert.

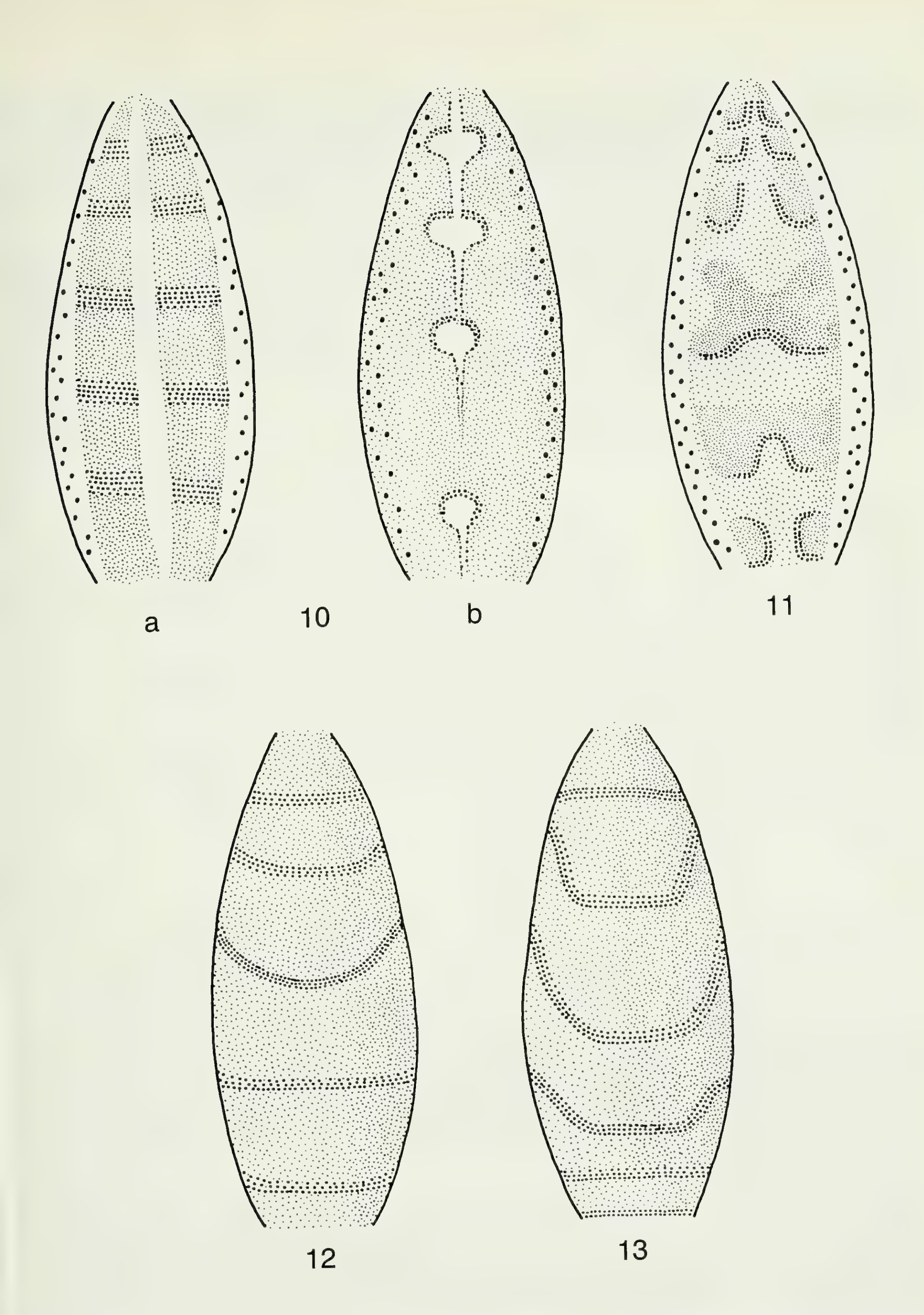


Abb. 10–13: Schematisierte Rückenzeichnungen kapverdischer Geckos der Gattung *Tarentola* (s. SCHLEICH, 1984): 10a, b) *Tarentola gigas brancoensis;* 11) *Tarentola gigas gigas;* 12) *Tarentola caboverdiana nicolauensis;* 13) *Tarentola caboverdiana caboverdiana.*

In der Färbung und Zeichnung sind die Tiere von allen anderen kapverdischen Geckos gut zu unterscheiden. Die Grundfärbung ist gräulich bis graubraun, der Bauch hell. Eine dorsale Bänderzeichnung ist kaum bis nur sehr schwer erkennbar; vier bis fünf Bänder können gezählt werden. Im allgemeinen ist jedoch eine silbrig graue Grundfärbung mit dunkler Sprenkelung vorhanden. Die Supralabialia sind dunkel gefleckt, die Sublabialia können hell bleiben. Ein schwacher heller Streifen verläuft von den Nasenlöchern zum vorderen Ohrrand.

Anmerkung: JOGER (1984: 98) gibt an, daß von Sal ein Einzeltier in sehr schlechtem Erhaltungszustand überliefert ist und begründet die mögliche Artzurechnung zu *darwini* lediglich mit der hohen Anzahl der Rückentuberkel. Weitere Angaben über Herkunft und Aufsammlung fehlen. Für die Zuordnung von JOGER'schen *darwini*-Typen von S. Nicolau bestehen ebenfalls Zweifel, und er selbst schreibt (S. 97): ,,Die Zuordnung dieser beiden Exemplare erfolgt unter Vorbehalt."

Maßtabelle

Tarentola darwini von Tarrafal / S. THIAGO

											Mentale			Tub.	Lam.	
Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	AS	MSP	L	B	OL/UL	R.	1/3	Bd
29.82.1	–	52,0	–	11,5	12,0	2,2	3,8	7,0	7,5	11,5	4,5	2,5	13/10	16	–	–
29.82.2	–	51,7	–	17,0	12,5	2,6	4,5	7,0	7,0	12,1	4,5	2,1	12/8	18	–	4
29.82.3	–	56,0	–	16,0	11,5	2,8	4,1	6,1	7,1	12,7	4,2	2,3	10/9	16	–	(4) 5
29.82.4	–	52,0	–	15,5	12,0	2,7	4,3	6,4	7,2	12,0	4,1	2,1	9/7	16	–	5
29.82.5	–	54,5	–	17,0	13,5	3,5	4,0	7,0	7,2	10,3	–	–	8/7	16	–	4
29.82.6	–	54,8	–	14,5	12,5	2,2	4,2	6,8	7,0	10,8	4,1	2,2	10/8	16	–	4
29.82.7	–	55,3	–	17,2	12,0	2,5	4,8	7,0	7,1	12,3	4,5	2,5	9/7	16	–	4
29.82.8	–	57,9	–	18,0	12,3	2,6	4,5	6,5	7,0	13,0	5,0	2,2	9/9	16	–	5
365.78.1	–	46,6	–	15,8	10,9	1,8	4,5	5,3	6,2	10,4	–	–	10/7	16	–	5
147.81.1	–	56,8	–	16,1	14,0	2,5	4,0	6,8	7,0	10,5	5,0	2,3	10/9	14	9/13	5
147.81.2	–	56,0	–	15,0	11,7	2,3	3,9	4,4	6,4	9,0	4,5	2,7	9/7	16	–	5
146.82.1	110,0	60,2	49,8	17,0	13,0	2,2	4,0	7,4	7,3	11,3	5,5	2,5	10/9	16	–	5
146.82.2	–	53,5	–	18,0	12,7	2,0	5,0	5,4	7,0	12,5	5,0	2,2	9/7	16	–	5

4.2.3 *Tarentola caboverdiana* Schleich, 1984

4.2.3.1 *Tarentola caboverdiana caboverdiana* Schleich, 1984 (Taf. IV, Fig. 6)

Material: 30 Ex. Holotypus – ZSM 141/81.03, Paratypen – ZSM 141/81.01–02; 141/81.04 – 17.

1947 *Tarentola delalandii delalandii.* – LOVERIDGE (part.)
1954 *Tarentola delalandii rudis.* – MERTENS (part.)
1984 *Tarentola caboverdianus.* – SCHLEICH
1984 *Tarentola caboverdiana.* – JOGER

Terra typica: St. Antão

Diagnose (s. SCHLEICH 1984: 98ff.):

Gesamtlänge bis 103 mm, wobei die Schwanzlänge immer geringer als die Kopfrumpflänge ist. Die Kopflänge ist 1,5–1,8mal die Kopfbreite (1mal 1,2×). Der Ohrschlitz ist meist länger als der halbe Augdurchmesser. Die Entfernung Ohr–Auge ist gleich lang oder kürzer als Auge/Schnauzenspitze. 3 Submaxillaria. 14–16 Tuberkelreihen mit caudaler Farbintensivierung.

Beschreibung:

Die bis 103 mm lang werdenden Tiere besitzen einen relativ schlanken Kopf. Der Schwanz ist dorsoventral abgeflacht, immer kürzer als die Kopfrumpflänge und erscheint dorsal hell/dunkel geringelt.

Die Dorsaltuberkel sind leicht gekielt und in 14 bis 16 Längsreihen angeordnet. Die Zahl der Oberlippenschilder schwankt zwischen 9 und 13, jene der Unterlippenschilder zwischen 7 und 10. Zwischen Augen und Nasenlöchern verläuft ein heller, dunkel gesäumter Streifen, der sich zwischen Auge und Ohr fortsetzt. Die Labialia sind weiß gefärbt. Die Rückenzeichnung besteht aus 4–6, meist 5, Transversalbändern.

Maßtabelle

Tarentola caboverdiana caboverdiana von St. ANTÃO

											Mentale			Tub.	Lam.	
Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	AS	MSP	L	B	OL/UL	R.	1/3	Bd
141.81.1	–	53,5	–	16,0	12,0	2,6	4,0	7,0	7,0	10,5	5,0	2,0	11/9	16	–	(4) 5
141.81.2	–	60,0	–	17,5	14,0	2,5	4,0	7,0	9,0	12,0	5,2	3,0	13/9	16	–	(4) 5
141.81.3	97,2	50,0	47,2	16,6	11,4	2,0	4,2	6,1	7,6	10,3	4,5	1,9	10/10	16(17)	–	5
141.81.4	–	52,5	–	16,3	10,0	3,0	3,5	6,0	7,0	9,8	4,5	2,9	9/8	14	–	6
141.81.5	–	48,2	–	16,0	12,0	1,9	3,5	5,9	7,1	10,0	4,5	2,2	10/8	16	–	5
141.81.6	99,0	54,5	45,5	11,1	12,0	2,8	3,5	6,0	6,8	9,8	4,5	2,3	9/9	14	–	5
141.81.7	103,0	54,0	49,0	18,0	12,5	1,8	4,0	7,0	7,5	10,5	5,0	2,1	10/8	16	–	5
141.81.8	82,0	44,0	36,0	14,7	10,3	1,8	3,8	5,0	6,5	9,1	4,5	2,0	9/8	14	–	4
141.81.9	96,0	49,5	46,5	14,9	11,0	2,0	4,0	5,5	7,0	8,9	4,5	2,0	9/8	14	–	5
141.81.10	–	46,2	–	14,5	10,2	1,8	3,8	5,6	6,2	8,5	4,5	1,4	9/–	16	–	6
141.81.11	90,5	50,5	40,0	15,0	12,0	2,2	3,7	6,0	7,0	9,5	5,0	2,0	9/8	16	–	5
141.81.12	90,0	45,5	44,5	15,0	11,6	2,1	4,0	6,0	7,0	10,0	4,0	1,6	10/9	16	–	5
141.81.13	61,0	32,0	29,0	11,1	7,0	1,3	2,8	4,0	4,8	7,5	3,0	1,5	9/8	16	–	5
141.81.14	–	46,0	–	11,5	10,5	2,3	3,9	6,0	6,9	9,8	3,2	1,9	9/7	16	–	5
141.81.15	–	47,0	–	16,9	10,4	2,0	3,5	4,0	7,5	10,0	4,5	2,0	9/8	14	–	5
141.81.16	77,0	38,5	38,5	14,2	13,9	2,0	3,2	5,0	6,0	8,0	3,8	1,9	10/8	16	–	5
141.81.17	81,0	43,1	37,9	14,5	10,0	2,0	3,0	5,2	6,1	9,9	4,1	2,0	11/9	16	–	5

4.2.3.2 *Tarentola caboverdiana nicolauensis* Schleich, 1984 (Taf. IV, Fig. 4)

Material: 11 Ex. Holotypus – ZSM 138/81.2, Paratypen – ZSM 138/81.1,3–11.

1984 *Tarentola caboverdianus nicolauensis* SCHLEICH

1984 *Tarentola c. nicolauensis.* – JOGER

Terra typica: S. Nicolau

Verbreitung: S. Nicolau

Diagnose (s. SCHLEICH 1984: 100):

Kopf-Rumpflänge bis 61 mm, Schwanzlänge annähernd gleichlang KR-Länge. Kopflänge 1,2–1,5mal Kopfbreite. Der Abstand Ohr–Auge ist deutlich kleiner als vom Auge zur Schnauzenspitze. 14–18 Tuberkelreihen; Tuberkel länglich, „kantig". 9–11 Supra- und 8–9 Sublabialia. 4–6, meist aber 5 Transversalbänder.

Beschreibung:

Die Art wird bis ca. 120 mm lang, ihr Kopf-Rumpf/Schwanz Längenindex entspricht 1,1. Der Schädel ist etwa 1,1- bis 1,5mal so lang wie breit. Zwischen 9–11 Supra- und 8–9 Sublabialia sind ausgebildet. Auf dem dorsalen Ohrrand liegen meist zwei kleinere Schuppengranulae. 14–18 dorsale Tuberkellängsreihen können ausgebildet sein. Zwischen Nasenloch und Augrand verläuft je ein heller, dunkel gesäumter Streifen, die Lippenschilder sind einheitlich weiß. Die Rückenzeichnung besteht aus 4–6 meist dünnen Transversalbändern.

Maßtabelle

Tarentola caboverdiana nicolauensis von S. NICOLAU

											Mentale			Tub.	Lam.	
Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	AS	MSP	L	B	OL/UL	R.	⅓	Bd
138.81.1	115,0	57,0	58,0	16,9	13,8	2,1	4,0	6,0	7,5	10,9	4,5	1,9	9/8	18	12/14	5
138.81.2	107,0	52,0	55,0	17,0	13,0	2,4	4,0	5,9	7,3	10,0	4,2	2,2	10/9	14	12/14	5
138.81.3	91,0	45,0	46,0	12,8	10,9	2,0	3,5	4,8	6,8	9,7	3,8	1,5	10/9	16	12/14	5
138.81.4	84,0	43,0	41,0	13,7	10,5	2,0	3,2	5,0	6,5	9,1	3,7	1,5	10/8	15	13/13	5
138.81.5	–	57,0	–	15,5	13,8	2,5	4,0	5,7	8,0	11,0	4,6	2,1	10/8	18	12/14	5
138.81.6	–	52,0	–	14,5	11,8	2,0	3,9	5,2	7,4	10,4	4,6	2,0	11/8	16	13/13	5
138.81.7	–	61,0	–	18,9	13,5	2,5	4,5	5,5	8,5	12,5	4,6	1,9	9/8	18	12/14	6
138.81.8	–	58,0	–	17,2	12,2	2,0	3,9	5,0	7,5	10,8	4,4	1,7	11/9	16	12/15	5
138.81.9	117,0	60,0	57,0	20,0	13,5	2,3	4,5	5,9	8,5	11,8	4,6	2,3	9/9	16	14/14	5
138.81.10	114,0	55,0	59,0	17,1	12,7	2,3	4,2	5,0	7,7	11,3	4,4	1,9	11/9	16	12/14	4
138.81.11	–	58,0	–	19,0	13,1	2,4	4,3	5,7	8,5	12,0	5,0	1,9	10/9	17	13/14	5

4.2.3.3 *Tarentola caboverdiana raziana* Schleich, 1984 (Taf. II, Fig. 8; Taf. III, Fig. 1; Taf. IV, Fig. 5)

Material: 20 Ex. Holotypus – ZSM 133/81.1 von St. Luzia, Paratypen – ZSM 133/81.2–10 v. St. Luzia, 134/81.1–10 v. Razo.

1984 *Tarentola caboverdianus razianus* SCHLEICH
1984 *T. c. raziana.* – JOGER

Terra typica: St. Luzia
Verbreitung: St. Luzia, Razo

Diagnose (s. SCHLEICH 1984: 101):

Kopf-Rumpflänge bis 60 mm; die Kopflänge beträgt 1,2–1,6mal der Kopfbreite. Die Entfernung zwischen Auge–Schnauzenspitze ist deutlich länger als jene zwischen Ohr und Auge. 9–11 Supra- und 8–9 Sublabialia sind ausgebildet. 16 Tuberkelreihen und 3 bis max. 4 Transversalbänder zieren den Rücken.

Beschreibung:

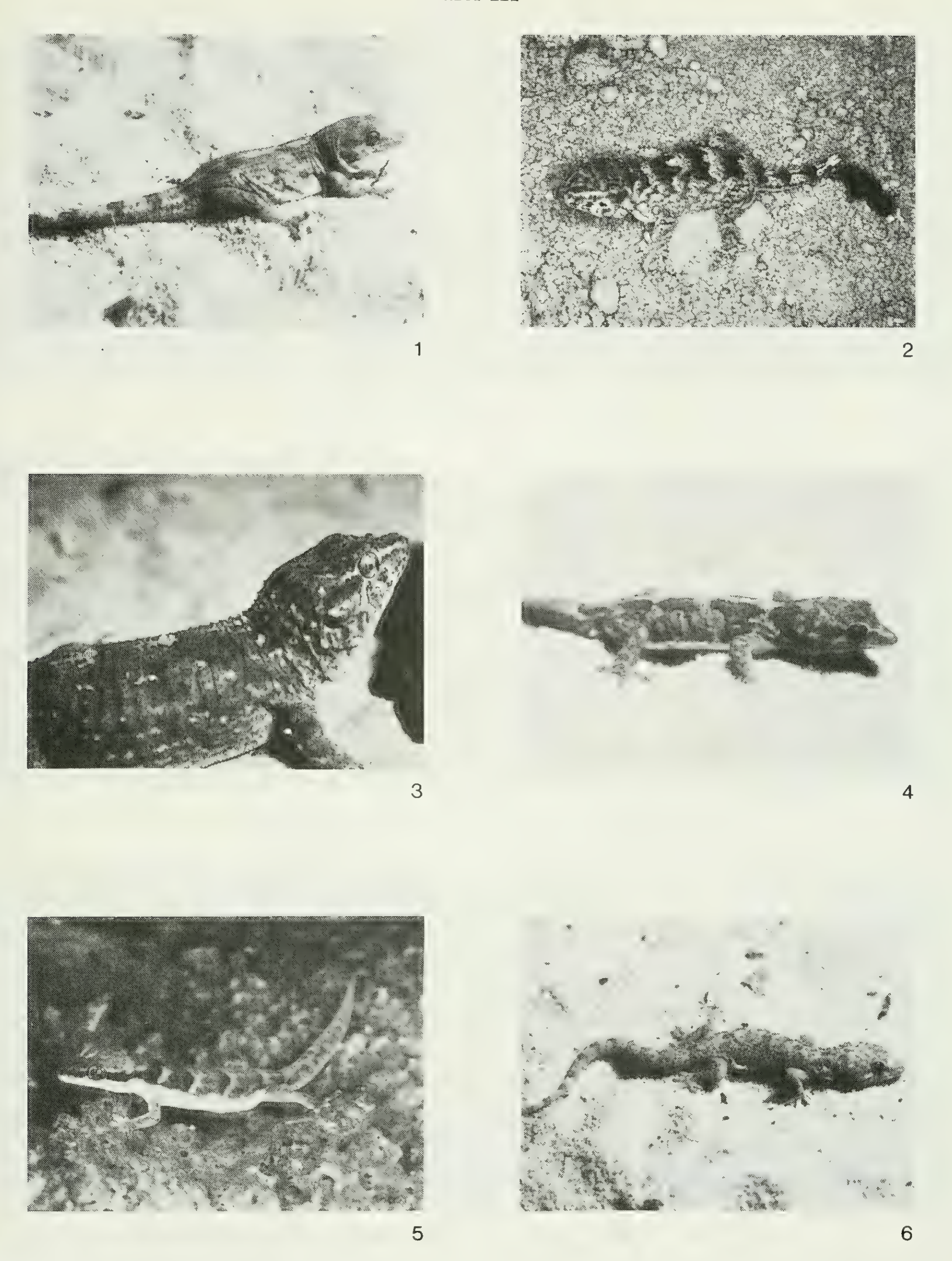
Lediglich ein Individuum der Serie von 20 Exemplaren hat einen unregenerierten Schwanz, der etwas länger als die Kopf-Rumpflänge ist. Die KR-Länge beträgt max. 60 mm. Die Kopflänge mißt 1,2–1,6mal der Kopfbreite. Der kleine Ohrschlitz ist nur etwa halb so lang wie der Augdurchmesser. Der Abstand vom vorderen Ohrrand zum Auge ist deutlich kürzer als jener zwischen Augvorderrand und Schnauzenspitze. Zwischen 9–11 Supra- (meist 10) und 7–9 (meist 8 od. 9) Sublabialia sind ausgebildet. Die Tuberkel sind in 16–18 Längsreihen angeordnet und von rundlich kegelförmiger, leicht gekielter Gestalt. Die Tiere sind einheitlich braungrau gefärbt und tragen drei bis vier sich caudal verdunkelnde Transversalbänder, wobei entweder das 4. oder 5. auf der Schwanzbasis liegt. Das Schwanzregenerat ist bei lebenden Exemplaren rötlich. Zwischen Nasenloch und Ohröffnung verläuft je ein heller, dunkel gesäumter Streifen. Zumindest die Sublabialia sind kaum oder nicht gefleckt und weiß.

Maßtabelle

Tarentola caboverdiana raziana von St. LUZIA

											Mentale			Tub.	Lam.	
Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	AS	MSP	L	B	OL/UL	R.	⅓	Bd
133.81.1	–	55,2	–	19,3	13,0	1,5	3,8	6,0	6,8	11,4	5,0	2,0	10/9	16	10/13	4
133.81.2	–	54,5	–	15,5	12,5	2,5	4,0	6,0	7,5	11,3	5,0	2,1	11/9	16	–	4
133.81.3	–	55,6	–	17,2	12,3	2,1	4,4	5,2	7,2	11,5	5,0	2,0	11/9	16	–	3

Tafel III



Tafel III: Fig. 1: *Tarentola caboverdiana raziana* von Razo; adultes Exemplar. Fig. 2: *Tarentola gigas gigas* von Razo; frisch geschlüpftes Jungtier. Fig. 3: *Tarentola gigas brancoensis* von Branco; adultes Exemplar. Fig. 4: *Hemidactylus bouvieri boavistensis* von Sal; Straße nach St. Maria; adultes Tier. Fig. 5: *Hemidactylus bouvieri razoensis* von Razo; adultes Tier. Fig. 6: *Hemidactylus brooki angulatus* von Sal; adultes Tier.

133.81.4	–	49,5	–	17,5	11,0	2,5	4,8	5,2	7,1	11,0	5,0	2,2	9/8	16	–	3
133.81.5	–	48,5	–	15,0	11,0	1,9	4,5	5,0	7,2	10,8	4,5	1,7	11/9	16	–	3
133.81.6	–	51,7	–	16,5	12,0	2,0	4,0	5,2	7,0	11,0	4,5	2,1	10/8	16	–	4
133.81.7	–	54,0	–	17,6	11,0	2,3	4,5	5,0	7,2	11,5	5,0	2,5	10/9	16	–	4
133.81.8	–	53,0	–	17,0	11,5	2,5	3,8	5,0	7,0	10,8	4,7	2,6	10/8	16	–	3
133.81.9	–	56,5	–	18,5	12,3	2,0	4,0	6,0	6,9	12,0	4,5	2,1	9/8	16	–	4
133.81.10	–	49,0	–	16,5	11,5	2,3	4,0	5,0	7,0	6,8	4,5	2,0	10/9	16	–	4
				von RAZO												
134.81.1	–	60,0	–	18,5	14,0	2,0	4,8	6,2	7,0	11,3	5,0	2,4	10/9	16	–	3
134.81.2	–	48,5	–	16,5	11,0	2,0	4,0	5,0	7,0	10,9	4,0	2,0	10/9	16	–	4
134.81.3	–	56,0	–	18,3	13,0	2,2	4,0	6,2	8,1	13,0	5,0	2,2	10/9	16	–	4
134.81.4	89,0	42,5	46,5	13,8	10,5	2,0	3,9	5,0	7,0	11,2	4,5	2,0	9/8	18	–	4
134.81.5	–	48,0	–	15,0	11,0	2,0	4,0	5,0	7,0	11,0	4,0	2,0	10/9	18	–	3
134.81.6	–	42,0	–	15,0	10,0	1,8	4,0	5,0	7,1	10,5	4,0	2,0	10/8	16	–	4
134.81.7	–	53,0	–	16,6	11,0	2,5	4,0	5,0	7,0	12,0	4,5	2,2	10/8	16	–	4
134.81.8	–	43,5	–	15,0	10,5	1,7	3,5	4,5	6,0	10,3	4,5	1,8	10/7	18	–	4
134.81.9	–	54,0	–	16,5	13,3	1,8	4,2	5,5	7,5	11,5	4,6	2,5	10/8	18	–	4
134.81.10	–	59,0	–	19,0	14,4	2,7	4,3	6,5	8,0	12,3	4,9	2,0	10/8	18	–	4

4.2.3.4 *Tarentola caboverdiana substituta* Joger, 1984 (Taf. II, Fig. 7)

Material: 17 Ex. ZSM 371/78; 140/81.1–10.

1984 *Tarentola caboverdianus caboverdianus.* – SCHLEICH (part.)
1984 *Tarentola caboverdiana substituta.* – JOGER

Terra typica: S. Vicente
Verbreitung: S. Vicente

Diagnose (s. JOGER 1984: 103):

„Schuppen kleiner als bei den anderen Subspezies, daher mehr Schuppen um die Körpermitte: 146–167. Vorderbeine kürzer als die Kopflänge (bei allen anderen Kapverdengeckos mindestens ebenso lang). 4–5 Rückensättel, caudal oft von weißen Tuberkeln umrahmt, vom Nacken bis in die Sakralregion. Maximale Kopf-Rumpf-Länge 60 mm (♂), 56 mm (♀)."

Anmerkung: Eigenartigerweise erwähnte JOGER das ihm zur Verfügung gestandene Münchner Material hier nicht. Es ist zu hoffen, daß das von ihm beschriebene Material dieser zum Großteil lang zurückliegenden Aufsammlungen wirklich von S. Vicente stammt und dessen Herkunft – wie bei vielen anderen alten Kapverdenkollekten – nicht nur gemutmaßt wurde.

An den von mir selbst gesammelten Tieren von S. Vicente und deren untersuchten Merkmalen ergaben sich für mich keine signifikant genug erscheinenden Differenzierungsmöglichkeiten für einen berechtigten eigenen Unterartstatus, so daß ich nach den von JOGER untersuchten Merkmalen die Art hier übernehme und die morphometrischen Werte der Münchner Exemplare hier mit anführe.

Beschreibung:

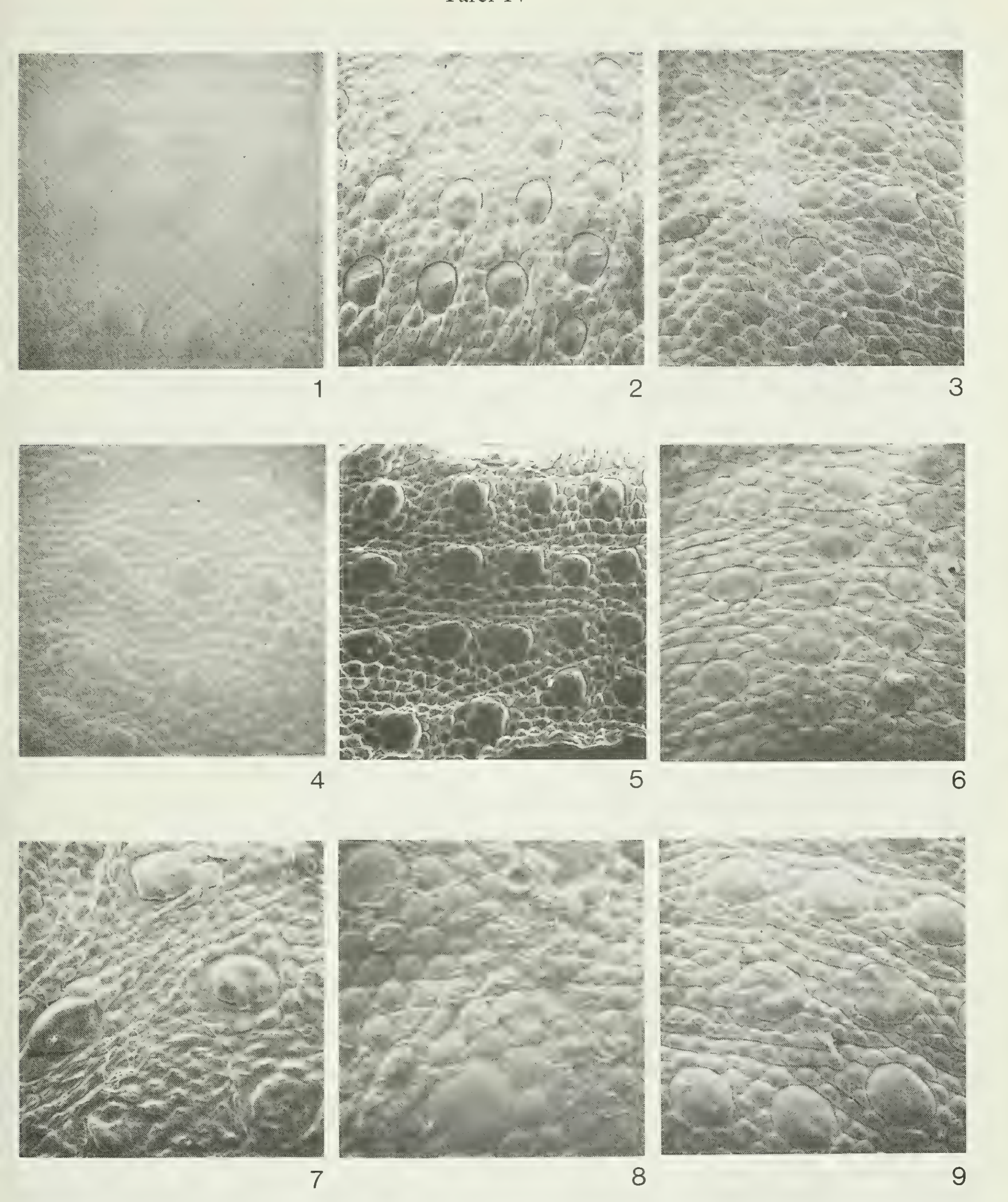
Für die von mir selbst gesammelten und in der ZSM hinterlegten Exemplare gilt:

Die Kopf-Rumpflänge des größten Exemplares beträgt 57,3 mm bei einer Schwanzlänge von 55,7 mm; hieraus ergibt sich eine max. Gesamtlänge für die gefangenen Exemplare von 113 mm.

Die Kopflänge mißt 1,2 bis 1,8(MW 1,6)mal der Kopfbreite. Der Ohrspalt ist etwa so lang oder größer als der halbe Augdurchmesser.

Der Abstand vom vorderen Ohrrand zum Auge ist kürzer als der vom Augvorderrand zur Schnauzenspitze. Die Länge des Maulspaltes reicht deutlich hinter den hinteren Augenrand. Das Mentale ist etwa doppelt so lang wie breit. An Lippenschildern sind 8–11 Supra-/, 7–9 Sublabialia ausgebildet. Zwischen 14 u. 20 Tuberkelreihen können gezählt werden. Die Rückenzeichnung besteht aus 4–5 Bändern.

Tafel IV



Tafel IV: Dorsolateraltuberkel kapverdischer *Tarentola;* REM-Aufnahmen. Fig. 1: *Tarentola rudis maioensis* von Maio; 22×. Fig. 2: *Tarentola rudis rudis* von Praia-S. Thiago; 25×. Fig. 3: *Tarentola darwini* von Tarrafal-S. Thiago; 24×. Fig. 4: *Tarentola caboverdiana nicolauensis* von S. Nicolau; 22×. Fig. 5: *Tarentola caboverdiana raziana* von St. Luzia; 23×. Fig. 6: *Tarentola caboverdiana caboverdiana* von St. Antão; 23×. Fig. 7: *Tarentola rudis* cf. *protogigas* von Fogo; 24×. Fig. 8: *Tarentola gigas brancoensis* von Branco; 29×. Fig. 9: *Tarentola gigas gigas* von Razo; 26×.

Maßtabelle

Tarentola caboverdiana substituta von S. VICENTE

											Mentale			Tub.	Lam.	
Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	AS	MSP	L	B	OL/UL	R.	⅓	Bd
371.78.1	–	40,9	–	–	9,0	2,0	4,0	4,0	6,0	10,6	–	–	10/8	14	–	4
140.81.1	–	21,0	–	8,1	4,5	–	1,9	–	2,5	5,5	–	–	9/8	14	–	4
140.81.2	54,0	26,0	24,0	9,0	5,0	–	2,0	–	3,5	6,0	–	–	10/7	20	–	4
140.81.3	–	29,0	–	11,5	7,0	1,0	2,6	3,4	4,7	7,0	2,7	1,4	10/8	18	–	4
140.81.4	–	40,0	–	13,0	7,3	1,5	2,3	5,0	6,0	8,3	3,5	1,6	8/7	16	–	5
140.81.5	84,0	43,5	40,5	13,5	9,3	2,1	2,9	5,0	6,0	9,0	4,0	2,0	9/8	14	–	4
140.81.6	105,0	53,0	52,0	18,0	12,5	2,4	4,1	6,3	7,0	12,0	4,8	2,5	9/9	18	–	5
140.81.7	111,0	56,0	55,0	17,0	11,5	2,5	4,3	6,0	7,2	12,0	5,0	2,1	11/9	16	–	5
140.81.8	113,0	57,3	55,7	18,0	12,3	2,8	4,5	6,5	9,0	11,0	5,0	2,8	10/9	16	–	5
140.81.9	100,0	55,0	45,0	15,0	12,5	2,5	4,0	6,0	7,0	10,5	5,0	2,2	10/8	16	–	4
140.81.10	107,0	56,8	50,2	18,0	13,0	2,3	4,1	6,9	7,0	10,1	5,3	2,3	11/9	14	–	4

4.2.4 *Tarentola gigas* (Bocage, 1875)

1875 *Ascalabotes gigas* BOCAGE
1884 *Platydactylus gigas*. – ROCHEBRUNE
1885 *Tarentola gigas*. – BOULENGER
1896 *Tarentola gigas*. – BOCAGE
1907 *Tarentola giganteu*. – SCHERER
1937 *Tarentola gigas*. – ANGEL
1947 *Tarentola delalandii gigas*. – LOVERIDGE
1955 *Tarentola delalandii gigas*. – MERTENS
1979 *Tarentola delalandii gigas*. – SCHLEICH
1980 *Tarentola delalandii gigas*. – SCHLEICH
1982 *Tarentola „delalandii" gigas*. – SCHLEICH
1982 *Tarentola delalandii gigas*. – GRUBER & SCHLEICH
1983 *Tarentola delalandii gigas*. – BAEZ & SANCHEZ-PINTO
1983 *Tarentola delalandii gigas*. – SCHLEICH & WUTTKE
1984 *Tarentola gigas*. – SCHLEICH
1984 *Tarentola borneensis*. – JOGER

4.2.4.1 *Tarentola gigas gigas* (Bocage, 1875) (Taf. III, Fig. 2; Taf. IV, Fig. 9)

Material: 17 Ex. ZSM 131/1981; Razo.

1875 *Ascalabotes gigas* BOCAGE
1884 *Platydactylus gigas*. – ROCHEBRUNE
1885 *Tarentola gigas*. – BOULENGER
1896 *Tarentola gigas*. – BOCAGE
1907 *Tarentola giganteu*. – SCHERER
1937 *Tarentola gigas*. – ANGEL
1947 *Tarentola delalandii gigas*. – LOVERIDGE
1955 *Tarentola delalandii gigas*. – MERTENS
1984 *Tarentola gigas gigas*. – SCHLEICH
1984 *Tarentola b. borneensis*. – JOGER

Terra typica: Razo

Verbreitung: Razo; s. a. SCHLEICH & WUTTKE (1983). Die JOGER'sche Verbreitungsangabe (1984: 100) erscheint unbelegt, stammt aber vermutlich aus SCHLEICH & WUTTKE (op. cit.).

Diagnose:

KR-Länge bis 13,5 cm; kräftig gackernde Stimme. Kopflänge 1,2- bis 1,8mal der Kopfbreite. Kleine Rückentuberkel in 16 Längsreihen. Entfernung Ohr–Auge nur geringfügig kleiner als Entfernung Auge–Schnauzenspitze. Zwischen 9 und 12 (meist 10) Supra- und 7–9 (meist 8 oder 9) Sublabialia. Schwanz deutlich kürzer als KR-Länge. Mentale etwa doppelt so lang wie breit. 2–3 Submaxillaria sind ausgebildet.

Beschreibung:

Der kräftige Habitus der bis 13,5 cm KR-Länge (freilebend) messenden plumpen Tiere unterscheidet sie deutlich von allen anderen Arten der Gattung *Tarentola.* Das schwerste ♂ von über 80 auf Razo gemessenen Exemplaren wog 81 g. Geschlechtsdimorph sind die ♂♂ von den ♀♀ durch ihren deutlich breiteren Kopf zu unterscheiden. Der Maulspalt reicht bis hinter den Pupillenspalt. Die Tuberkel der in einzelnen Querreihen angeordneten Schwanzsegmente sind alternierend unterschiedlich groß. Die Rückenfärbung der Tiere ist meist hellgrau, die Bauchseite cremefarben. Die Zeichnung besteht aus in der Dorsomedianen unterbrochenen, aber auch durchgehenden Transversalbändern, die posterior dunkel gesäumt sind. Die Flanken sind gesprenkelt. Zwischen Nasenlöchern und Ohr verläuft ein dunkel gesäumter, heller Streifen. An einem Exemplar wurden an der ersten Zehe 14 und an der dritten 15 Subdigitallamellen gezählt. Eine Auswertung der umfangreichen Freilanduntersuchungen befindet sich in Bearbeitung.

Maßtabelle

Tarentola gigas gigas von RAZO

											Mentale			Tub.	Lam.	
Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	AS	MSP	L	B	OL/UL	R.	⅓	Bd
131.81.1	180,0	105,0	75,0	30,0	21,5	4,8	5,9	12,0	13,5	19,9	8,5	4,2	10/9	16	–	5
131.81.2	184,0	98,0	86,0	27,0	22,0	4,0	6,0	12,5	13,0	20,0	7,8	3,3	10/7	16	–	4
131.81.3	–	108,0	–	30,3	23,0	5,0	6,0	12,5	13,5	22,0	8,2	4,0	10/9	16	–	4
131.81.4	–	120,0	–	36,3	26,0	5,0	6,4	15,0	15,0	25,0	8,9	4,5	10/9	16	–	4
131.81.5	163,0	88,0	75,0	27,0	19,0	4,8	5,7	10,0	11,5	17,5	7,4	3,5	10/9	16	–	5
131.81.6	212,0	120,0	92,0	34,5	25,0	4,5	6,5	13,4	16,0	24,3	9,7	4,2	12/9	16	–	6
131.81.7	–	120,0	–	35,0	26,3	4,5	6,5	14,7	16,0	23,5	9,8	5,0	10/8	16	14/15	6
131.81.8	–	113,0	–	30,0	22,5	4,2	6,0	12,8	13,5	20,3	–	–	9/9	16	–	5
131.81.9	–	127,0	–	35,0	25,0	4,5	6,5	15,0	16,2	22,8	10,0	4,0	11/9	16	–	6
131.81.10	–	117,0	–	31,0	26,5	4,5	6,0	14,0	14,5	19,0	9,0	3,8	10/8	16	–	4
131.81.11	216,0	116,0	100,0	29,0	24,6	4,0	5,4	13,5	14,3	17,5	8,1	3,9	10/9	16	–	4
131.81.12	203,0	111,0	92,0	28,0	24,0	3,8	5,5	12,1	13,6	18,2	7,8	3,6	10/7	16	–	4
131.81.13	–	105,0	–	–	23,5	3,6	5,2	11,5	12,6	17,0	7,3	3,3	10/8	16	–	4
131.81.14	192,0	107,0	85,0	29,5	22,0	3,2	5,3	10,5	13,6	19,0	7,9	3,4	10/8	16	–	–
131.81.15	161,0	85,0	76,0	25,8	18,0	4,0	5,5	10,5	11,0	18,1	7,1	3,0	9/8	16	–	4
131.81.16	190,0	107,0	83,0	29,0	21,6	4,3	6,5	14,5	14,5	20,5	8,0	4,0	9/8	16	–	5
131.81.17	–	115,0	–	33,0	28,5	4,5	6,0	15,5	15,0	25,6	10,0	5,5	9/8	16	–	4

4.2.4.2 *Tarentola gigas brancoensis* Schleich, 1984 (Taf. III, Fig. 3; Taf. IV, Fig. 8)

Material: 18 Ex. Holotypus – ZSM 362/78.1, Paratypen – ZSM 362/78.2–6, 19/82.1–12.

1875 *Ascalabotes gigas* Bocage
1884 *Platydactylus gigas.* – Rochebrune
1885 *Tarentola gigas.* – Boulenger
1907 *Tarentola giganteu.* – Scherer
1937 *Tarentola gigas.* – Angel

1947 *Tarentola delalandii gigas.* – LOVERIDGE
1955 *Tarentola delalandii gigas.* – MERTENS
1980 *Tarentola delalandii gigas.* – SCHLEICH
1982 *Tarentola „delalandii" gigas.* – SCHLEICH
1984 *Tarentola gigas brancoensis.* – SCHLEICH
1984 *Tarentola b. borneensis.* – JOGER

Terra typica: Branco
Verbreitung: Branco

Diagnose:

Unterscheidet sich von der Nominatform durch geringere Körpergröße. KR-Länge nur bis 11,4 cm. Kräftig gackernde Stimme. KL 1,2- bis 2,2mal KB; kleine Rückentuberkel in 16 Längsreihen; Entfernung OA nur wenig kleiner als AS; Ohröffnung $^2/_3$ bis mehr als die Hälfte des Augdurchmessers. Zwischen 8–12 Supra- und 7–9 Sublabialia. Schwanz kürzer als KR-Länge. 2–3 Submaxillaria.

Beschreibung:

Die Maximalwerte von Geländemessungen an 100 Tieren im Frühjahr 1981 betrugen 11,4 cm KR-Länge mit einem Gewicht von ca. 53 g. Durch ihren kräftigen, gedrungen wirkenden Körperbau sind sie von den anderen *Tarentola*-Arten gut zu unterscheiden. Der Ohrspalt ist meist größer als die Hälfte des Augdurchmessers. Die Entfernung zwischen Auge/Schnauze ist nur wenig größer als zwischen Ohr/Auge. Falls eine Transversalbänderung ausgebildet ist, zählt man zwischen 4 und 6 Querbänder, die jedoch selten durchgehend sind, sondern durch einen hellen Dorsomedianstreifen oder längliche, miteinander verschmolzene Kernflecken getrennt sein können, die wiederum anterior dunkel gesäumt sind. Weitere Angaben s. SCHLEICH, 1980.

Eine Auswertung der umfangreichen Freilanduntersuchungen befindet sich in Bearbeitung.

Maßtabelle

											Mentale			Tub.	Lam.	
Nr. ZSM	GL	KR	SL	KL	KB	O	A	OA	AS	MSP	L	B	OL/UL	R.	$^1/_3$	Bd
19.82.1	75,0	42,0	33,0	14,0	9,8	1,5	4,0	5,5	7,0	10,0	4,5	1,5	9/8	16	–	4
19.82.2	–	113,0	–	–	25,0	4,0	6,0	12,5	13,5	21,4	9,0	3,3	12/9	16	–	5
19.82.3	–	98,5	–	26,0	20,3	4,5	5,5	11,5	12,2	20,0	7,0	3,6	11/9	16	–	5
19.82.4	–	108,0	–	31,2	24,0	4,1	6,0	13,0	13,0	20,1	7,5	4,0	12/8	16	–	5
19.82.5	–	98,0	–	31,0	22,9	3,6	6,1	12,0	13,0	20,3	8,1	4,0	12/9	16	–	6
19.82.6	–	113,0	–	31,1	24,5	3,5	6,0	11,2	12,8	22,0	8,8	5,0	11/9	16	–	5
19.82.7	–	99,0	–	–	22,5	4,8	6,0	12,0	13,0	19,5	8,0	4,0	9/8	16	–	5
19.82.8	–	108,0	–	27,8	24,9	3,7	5,2	12,2	13,1	17,7	8,1	3,5	8/8	16	–	4
19.82.9	–	92,0	–	25,0	20,6	3,8	5,3	11,3	12,5	15,5	7,0	3,0	10/7	16	–	4
19.82.10	174,0	94,0	80,0	25,5	22,0	3,2	5,2	10,1	12,0	16,2	6,7	3,1	11/8	16	–	–
19.82.11	–	92,0	–	25,0	19,5	3,0	5,5	10,0	11,5	15,0	7,1	3,2	9/7	16	–	4
19.82.12	–	110,0	–	30,0	24,4	3,5	5,6	13,0	13,3	18,0	8,1	3,7	9/8	16	–	4
362.78.1	–	91,3	–	26,8	21,1	2,5	5,8	9,5	11,3	17,5	8,0	3,1	11/9	16	13/14	5
362.78.2	–	74,7	–	23,2	16,0	3,2	5,0	8,9	10,2	16,5	6,1	3,1	9/7	16	–	4
362.78.3	–	35,0	–	12,0	8,5	–	–	–	–	–	–	–	–	–	–	–
362.78.4	–	87,8	–	29,0	26,0	3,2	5,5	10,0	11,0	19,0	7,3	3,0	10/9	16	–	4
362.78.5	–	80,0	–	25,0	21,0	2,8	4,8	10,5	11,0	18,0	7,5	3,0	10/8	16	–	4
362.78.6	–	92,0	–	28,5	22,5	2,6	5,6	10,0	12,0	19,0	7,5	3,8	9/8	16	–	4

4.2 Gekkonidae – Genus *Hemidactylus*

Anmerkung: Herr Dr. R. Crombie, Washington, teilte mir freundlicherweise mit, daß *Hemidactylus cyanogaster* von Girard (1858) von den Kapverden beschrieben wurde, jedoch erscheint eine Zuordnung bislang noch nicht möglich[1]).

4.2.5 *Hemidactylus brooki angulatus* Hallowell, 1852 (Taf. III, Fig. 6)

Material: 2 Ex. ZSM 149/1981; Praia, S. Thiago. 7 Ex. ZSM 151/1981; Sal. 4 Ex. ZSM 150/1981; S. Vicente. 4 Ex. ZSM 148/1981; Fogo.

1852 *Hemidactylus angulatus* Hallowell
1858 *Hemidactylus cyanogaster.* – Girard
1937 *Hemidactylus brooki.* – Angel
1947 *Hemidactylus brookii angulatus.* – Loveridge
1951 *Hemidactylus brookii angulatus.* – Dekeyser & Villiers
1955 *Hemidactylus brookii angulatus.* – Mertens
1982 *Hemidactylus brookii angulatus.* – Schleich

Terra typica: „afrikanische Westküste“
Bisherige Verbreitung: Sal, Boa Vista, S. Thiago, Fogo, Brava, St. Antão, S. Vicente, Ilhéu Grande
Nachgewiesen von: S. Thiago, Sal, S. Vicente, Fogo, ? Ilhéu St. Maria

Artcharakteristik nach:

Loveridge (1947) –
KR-Länge 51–69 mm; gewöhnlich 8 (4+4) Tuberkel auf 4 Schwanzsegmenten. Tuberkel der Dorsolateralia dreiflächig; weniger Supralabialia, durchschnittlich 8.

Diagnose:

KR-Länge bis 54 (69) mm, im Habitus ähnlich *Hemidactylus brooki brooki* mit Rückentuberkeln in 10–20 Längsreihen. ♂♂ mit 22–25 Präanofemoralporen; 4–6 Subdigitallamellen am ersten und 7–8 am dritten Finger.

Maßangaben für vom Autor gesammelte Exemplare:

Sal	KR	GL	S. Vicente	KR	GL
ZSM 151/81	6,0 cm	12,4 cm	Mindelho	5,4 cm	
	5,4 cm	reg	ZSM 150/81	6,1 cm	
	5,0 cm	reg		2,1 cm	
	4,6 cm	reg		1,9 cm	5,1 cm
	4,8 cm	reg			
	3,6 cm	7,6 cm	Fogo, S. Felipe	5,2 cm	
	4,8 cm		ZSM 148/81	5,4 cm	
	4,6 cm			6,1 cm	
				5,9 cm	
S. Thiago				5,9 cm	
Praia	3,2 cm			5,1 cm	10,7 cm
ZSM 149/81	3,6 cm				

[1]) Während der Drucklegung der Arbeit teilte mir Dr. R. Crombie/Washington freundlicherweise die Erwähnung von *Hemidactylus cyanogaster* durch Girard (1858) für die Kapverden mit, wofür ich ihm herzlich danken möchte. Girard gab eine kurze Beschreibung und Charakteristik sowie eine relativ umfangreiche Synonymie für die von ihm „im Oktober 1838 nach dem Leben gezeichneten Tiere von Praia (‚Port Praja, San Jago‘)“, woraus ersichtlich wird, daß er sein Material seinerzeit (1858: 284–285, Taf. 25) *Hemidactylus turcicus* zuschrieb.

4.2.6 *Hemidactylus bouvieri* (Bocourt, 1870)

4.2.6.1 *Hemidactylus bouvieri bouvieri* (Bocourt, 1870)

Material: 2 Ex. BMNH. 66.4.12.3,4; S. Vicente.

1870 *Emydactylus bouviere* Bocourt
1873 *Hemidactylus cessacii.* – Bocage
1884 *Hemidactylus bouvieri.* – Rochebrune
1885 *Hemidactylus bouvieri.* – Boulenger
1935 *Hemidactylus bouvieri.* – Angel
1937 *Hemidactylus bouvieri.* – Angel
1947 *Hemidactylus bouvieri bouvieri.* – Loveridge
1955 *Hemidactylus bouvieri bouvieri.* – Mertens
1982 *Hemidactylus bouvieri bouvieri.* – Schleich
1982 *Hemidactylus bouvieri bouvieri.* – Gruber & Schleich

Terra typica: S. Vicente
Bisherige Verbreitung: S. Vicente, St. Antão, S. Thiago, Fogo, Brava
Nachgewiesen von: S. Vicente

Artcharakteristika nach:

Mertens (1955) –

Von einem Exemplar von Praia; unter dem 1. Finger 4 (5, falls prox. dazugezählt wird) Haftlamellen. Oberseite dunkelgrau, durch 4 schmale, helle Querbinden unterbrochen. 7 Querbänder auf der Schwanzoberseite, jene auf der Schwanzwurzel bilden nach hinten gerichteten Winkel.

Loveridge (1947) –

Schnauze wenig länger als Entfernung zwischen Aug- und Ohröffnung. Schnauzengranula größer als rückwärtige. Nasenlöcher begrenzt vom Rostrale, 1 Labiale und 3–4 kleinen Nasalia.

7–8 obere Labialia, 6–7 untere Labialia. Ein Paar große Postmentalia in Kontakt mit Mittellinie sowie ein äußeres, aber kleines Paar Kinnschilder. Rücken mit ziemlich großen einheitlichen Granula. Ventralia glatt, gerundet, schindelartig. ♂♂ 2 Präanalporen; Finger frei, leicht verschmälert mit ziemlich kurzen Endgliedern, innerhalb Haftlamellen, 3 unter 1. Zehe, 4–5 unter Mittelzehe. Schwanz zylindrisch, dorsal mit glatten einheitlichen Schuppen, ventral mit glatten Schindelschuppen, deren Mittelreihe transversal vergrößert ist. Schwanzlänge geringfügig kürzer als KR-Länge.

Färbung: Dorsal schwach braun, mit dunklem Streifen von den Nasenlöchern über das Auge, der auf der Flanke und der Schwanzbasis fortgesetzt sein kann. Oberlippe weiß. Rücken mit 5–6 dunkelbraunen Querbändern, ventral hell, GL 67 (36+31) mm.

Diagnose:

Hemidactylus bouvieri bouvieri mißt bis ca. 38,5 mm KR-Länge. Unter der ersten Zehe besitzt *Hemidactylus bouvieri bouvieri* 3–4 und unter der 3. Zehe 4–5 Subdigitallamellen. Eine dorsale Bänderzeichnung ist für die Art charakteristisch, muß aber nicht immer ausgebildet sein.

Beschreibung:

Hemidactylus bouvieri unterscheidet sich von *Hemidactylus brooki* durch das Fehlen der Rückentuberkel. *H. bouvieri* konnte leider nie selbst von mir gefangen werden, so daß sich diese Angaben auf Leihmaterial aus dem Britischen Museum sowie auf Literaturangaben beziehen (s. Gruber & Schleich 1982). Die Größenvariabilität von 5 Exemplaren konnte in einem Diagramm (op. cit.: 305, Abb. 2) dargestellt werden. Die maximale Kopf/Rumpflänge scheint ca. 38 mm zu betragen und liegt damit zwischen *razoensis* und *boavistensis.* Die Anzahl der Subdigitallamellen beträgt 3–4 an der ersten und 4–5 an der dritten Zehe. Das Supralabiale ist mit der Nasenöffnung in Kontakt. Die beiden vorliegenden Exemplare tragen 5 sich caudal verdunkelnde braune Transversalbänder, wobei das erste im Nacken und das 6. auf Höhe des Oberschenkelansatzes beginnt.

4.2.6.2 *Hemidactylus bouvieri boavistensis* Boulenger, 1906 (Taf. III, Fig. 4)

Material: 8 Ex. ZSM 366/1978; Boa Vista. 9 Ex. ZSM 20/82; Sal, Straße zur Saline. 3 Ex. ZSM 21/82; Sal, Straße nach St. Maria.

1906 *Hemidactylus boavistensis* BOULENGER
1935 *Hemidactylus chevalieri.* – ANGEL
1937 *Hemidactylus chevalieri.* – ANGEL
1937 *Hemidactylus boavistensis.* – ANGEL
1947 *Hemidactylus bouvieri boavistensis.* – LOVERIDGE
1947 *Hemidactylus bouvieri chevalieri.* – LOVERIDGE
1951 *Hemidactylus bouvieri chevalieri.* – DEKEYSER & VILLIERS
1955 *Hemidactylus bouvieri boavistensis.* – MERTENS
1982 *Hemidactylus bouvieri boavistensis.* – GRUBER & SCHLEICH

Terra typica: Boa Vista
Bisherige Verbreitung: Boa Vista, Sal
Nachgewiesen von: Boa Vista, Sal

Artcharakteristika nach:

BOULENGER (1905) –

In Pholidose und Morphologie *Hemidactylus bouvieri* ähnlich, aber ziemlich stark verlängerte Zehen und mit mehr Lamellen. 4–5 davon unter der 1. und 6–8 unter der 3. und 4. Zehe. Das Paar Kinnschilder hinter der Symphyse ist ebenfalls länger als bei *bouvieri.* Dorsal gelb, rötlich oder blaß-graubraun, gewöhnlich dunkelbraun gesprenkelt, mit 5 gebogenen und welligen braunen, dunkelgesäumten Querbändern, wovon das erste zwischen den Augen über den Occiput und das zweite im Nacken läuft. Diese Bänder können von einer Reihe dunkelbrauner Flecken entlang der Rückenmittellinie unterbrochen sein, oder sie sind alle zusammen kaum unterscheidbar. Ein dunkler brauner Strich verläuft beidseits der Schnauze, mit einem gelblichen darüber liegenden. Schwanz mit mehr oder weniger unterschiedlich halbmondförmigen dunklen Rückenbändern bei weißer Ventralseite. Bei *Hemidactylus bouvieri* fehlen die hellen Streifen auf der Schnauze, und die dunklen Bänder seitlich des Kopfes reichen bis zum dunklen Nackenband.

Boa Vista von 0–600 m

	♂	♀		♂	♀
GL	81	83	Körper	28	29
SL	39	39	Vorderextr.	14	14
Kopflänge	14	15	Hinterextr.	18	19
Kopfbreite	10	11	(Angaben in mm)		

LOVERIDGE (1947) –

Hemidactylus bouvieri boavistensis unterscheidet sich von *Hemidactylus bouvieri bouvieri* nur in leicht verlängerten Fingern mit konsequent mehr Haftreihen, nämlich 4–5 unter der ersten Zehe, 6–8 unter der dritten und vierten. Dorsal, gräulich, gelblich oder rötlichbraun, ein dunkelbrauner Streifen vom Rostrale ist von oben gelb begrenzt und reicht bis zum Auge. Von Auge zu Auge zieht ein welliges dunkelgesäumtes Band, ein weiteres im Genick, drei weitere auf dem Rücken, der auch dunkel gesprenkelt oder einfarbig sein kann. Die Bänder können mesial von einer Serie dunkelbrauner Flecken unterbrochen oder beinahe weißlich sein. Dieser leichte helle canthal-Streifen fehlt bei *Hemidactylus bouvieri,* wobei der dunkle sich niemals bis zum Nackenband oder den Flanken wie bei *bouvieri* fortsetzt. – Größe: Gesamtlänge ♂ 81 (42 + 39), ♀ 83 (44 + 39).

MERTENS (1955) –

Von 33 Exemplaren von Sal und Boa Vista

Hemidactylus chevalieri von Sal ist identisch mit *boavistensis,* da die Zahl der Lamellen unter dem 1. Finger (4–5) sich auf 6 erhöhen kann. Zeichnung sehr variabel, neben Individuen mit dunklen Querbändern (1 Nacken-, 3 Rükken-, 1 Schwanzwurzelband) haben einige eine helle, dorsale Mittellinie, andere dagegen sind bis auf eine feine Tüpfelung zeichnungslos. Der regenerierte Schwanz ist meist hell mit 3 dunklen Längsstreifen.

Diagnose:

Von der Nominatform *bouvieri bouvieri* deutlich durch die etwa $^1/_5$ größere Körperlänge unterscheidbar. Die Anzahl der Subdigitallamellen beträgt an der ersten Zehe 5–6 und an der dritten Zehe 7–8. Kopf/Rumpflänge bis ca. 50 mm.

Beschreibung:

Hemidactylus bouvieri boavistensis ähnelt im Habitus mehr einer kleinen *Tarentola caboverdiana* als *Hemidactylus brooki angulatus.* Von letzterem ist er durch die gleichmäßig glattere Pholidose gut zu unterscheiden. Das erste Supralabiale steht in Kontakt mit dem Nasale. Die Tiere erreichen eine Gesamtlänge von ca. 80 mm. Die Größenverteilung der gesammelten Exemplare ist in Gruber & Schleich (1982: 305, Abb. 2) in einem Diagramm dargestellt.

Die Anzahl der Subdigitallamellen beträgt bei *Hemidactylus bouvieri boavistensis* 5–6 an der ersten und 6–8 an der dritten Zehe.

Die Tiere können einfarbig hell gefärbt oder stark akzentuiert gebändert sein, wobei dann die meist vier bis fünf Transversalbänder dunkel gesäumt sind.

4.2.6.3 *Hemidactylus bouvieri razoensis* Gruber & Schleich, 1982 (Taf. III, Fig. 5)

Material: Holotypus: ZSM 129/1981; Razo. Paratypen: 5 Ex. ZSM 130/1981; Razo. 1 Ex. ZSM 22/1982; Razo.

1982 *Hemidactylus bouvieri razoensis* Gruber & Schleich
1983 *Hemidactylus bouvieri razoensis.* – Schleich & Wuttke

Terra typica: Razo
Verbreitung: Razo

Diagnose (nach Gruber & Schleich 1982):

„Die neue Form zeichnet sich durch ihre geringere Körpergröße (KR max. = 29 mm) sowie eine verringerte Anzahl von Subdigitallamellen (1. Finger: 2–3; 3. Finger: 4, selten 5) aus. Die Nasenöffnungen stehen nicht in direktem Kontakt mit den ersten Labialia."

Beschreibung (nach Gruber & Schleich 1982):

Habitus

Die Schnauze der Tiere ist spitz, ihre Beine sind kurz; das nach vorne gelegte Hinterbein reicht nicht bis zur Achselhöhle. Der runde Schwanz ist spitz auslaufend und an der Basis etwas dünner als in der Mitte. Der Augdurchmesser beträgt durchschnittlich 1,9 mm.

Pholidose

Die Schnauze ist – vor allem zwischen Auge und Nasale – von gegenüber den Dorsalia vergrößerten, oft hexagonalen Schuppen bedeckt. Von den beiden Postnasalia trennt das jeweils untere die Nasenöffnung vom ersten Supralabiale. In Ausnahmefällen kann das untere Postnasale – unter Verbleib einer schwachen Naht – mit dem Labiale verwachsen sein. Je sieben bis acht Supralabialia sind ausgebildet, wobei das letzte hinter der Augenmitte liegt. Sie sind durch mindestens eine Reihe kleiner Schuppen vom Auge getrennt. Die Pileusschuppen sind nur geringfügig kleiner als die Dorsalia.

Das nach hinten spitz zulaufende Mentale endet auf halber Länge zwischen dem ersten der beiden aneinanderliegenden Paare der Postmentalia. Die je sechs bis sieben Sublabialia werden von vergrößerten Gularia gesäumt. Die Gularia sind von rundlicher Form, flach und kleiner als die Dorsalia. Diese sind glatt, rundlich und nach hinten zunehmend gewölbt. Alle Dorsalia sind annähernd gleich groß. Die dorsalen Schwanzschuppen sind rechteckig, größer als die Dorsalia und in Querreihen angeordnet. Die vergrößerten Ventralia haben eckige Gestalt, überlagern sich und sind in der Körpermitte in ca. 25 versetzten Längsreihen angeordnet. Die stark vergrößerten Subcaudalia sind oft in nur einer Reihe vorzufinden. Alle Exemplare weisen beiderseits der Schwanzwurzel zwei, selten einen Postanaltuberkel auf, die bei den ♂♂ deutlicher ausgeprägt sind. Die Anzahl der mit Haftborsten versehenen Subdigi-

tallamellen beträgt am 1. Finger drei und am 3. Finger vier (selten fünf oder eine zusätzliche, vergrößerte basale Schuppe). Weist der 1. Finger nur zwei Lamellen auf, ist meist ebenfalls eine vergrößerte basale Schuppe zu erkennen. Das Rostrale ist hinten schmäler und von dort zu $^{2}/_{3}$ seiner Länge in der Mitte gespalten. Im Anschluß daran befinden sich zwei, selten drei große Internasalia.

Färbung

Kopf und Körperseite sind sandfarben. Die Rückenzeichnung besteht aus fünf 2–3 mm breiten, dunkelbraunen Transversalbändern, die nach caudal zunehmend dunkler werden. Das erste befindet sich am Nacken, das letzte an der Schwanzbasis. Auf der Schwanzoberseite verwischt die Bänderstruktur der Zeichnung, während die Grundfarbe des Schwanzes in Orange übergeht. Der vordere, obere Augenrand ist gelblich, ebenso die Labialia. Über den Supralabialia zieht sich ein dunkler Streifen von der Schnauzenspitze über das Auge bis zum lateralen Ende des ersten, selten des zweiten Transversalbandes. Ventral dieses Streifens erstreckt sich ein weißes Lateralband vom Mundwinkel bis zur Schwanzwurzel. Die Bauchseite ist weißlich, etwas durchscheinend und mit feinen, schwarzen Sprenkeln überzogen.

Diskussion (siehe Gruber & Schleich 1982).

4.3 Testudines

Nur sehr wenige Literaturangaben gibt es zu Schildkrötenhinweisen auf den Kapverden.

Boulenger (1905: 197) erwähnte „*Chelone imbricata*" von Fogo, und Bannerman & Bannerman (1968: 40) berichten aus Bourne's Expedition von 1951 über die Rhombos-Inseln: ... „as one comes ashore on little beaches of white sand marked with the excavations of turtles", und von Maio (op. cit.: S. 14) ... „and at a certain Season of the Year, as May, June, July and August, a sort of small sea-tortoise came hithere to lay their eggs; but these turtles are not so sweet as those in the West Indies."

Schleich (1979) berichtete über eine „Sea Turtle Protection needed at the Cape Verde Islands" und erwähnt dabei „Hawksbill" and „Loggerhead" als die durch intensiven Fang gefährdeten Arten. In den „vorläufigen Mitteilungen zur Herpetofauna der Kapverden" Schleich (1982: 247) werden vier Arten von Seeschildkröten, die auf den Kapverden vorkommen und intensivst bejagt werden, erwähnt: *Caretta caretta caretta, Eretmochelys imbricata, Chelonia mydas mydas* und *Lepidochelys olivacea olivacea.*

Neben dem großen Schaden durch hohe jährliche Abfangraten und Sammeln sowohl der Tiere als auch ihrer Gelege durch Privatleute, Fischer und bislang der staatlichen Fischereiindustrie, wurden die Bestände der Seeschildkröten stark dezimiert. Nicht unerwähnt soll trotzdem ihre Bedeutung auf den Kapverden als Eiweißlieferant, aber auch die Verwendung des Rückenpanzers als Transportbehältnis sein. Nach meinem Bericht (Schleich 1979) und intensivem Drängen bei den Fischereibehörden wurde mir von Direktor M. Duarte-Almeida seitens der SCAPA versichert, daß der industriell-gewerbliche Schildkrötenfang verboten wird. Andererseits werden natürlich noch immer genug Tiere auf dem Markt angeboten oder direkt von den Fischern gehandelt. Auch das Absuchen weiter Sandstrände nach frischen Gelegen seitens der Einheimischen sowie streunender Hunde führt zu einer weiteren intensiven Bedrohung der Tiere. Die Verfolgung eines Schutzprojektes wäre hier dringlichst notwendig!

Als bevorzugt „angelaufene" Inseln gelten natürlich alle mit flachen Sandstränden und Buchten, so besonders Sal, Boa Vista, Maio, S. Vicente, St. Lucia und Branco. Auf Maio wurde mir berichtet, daß die Seeschildkröten zwischen Mai und Juni zur Eiablage an Land gehen und dort sofort von den Einheimischen gefangen werden. Offiziell sei nur eine Rate von ca. 70 Tieren bekannt, Herr M. Rivas (frdl. mdl. Mittlg./20. 1. 81) nahm jedoch eine Dunkelziffer von mehr als 100 Tieren pro Jahr an.

Das von Mertens (1955) für Ilhéu St. Maria (in der Hafenbucht vor Praia gelegene kleine Insel) erwähnte Vorkommen von Süßwasserschildkröten der Art *Pelusios subniger derbianus* wurde von mir (Schleich 1982) als nicht mehr existent und seinerzeit anthropogen eingeführt, abgehandelt.

4.4 Amphibia – Bufonidae
Bufo regularis Reuss

Material: 11 Ex. ZSM 18/1982; S. Nicolau. 3 Ex. ZSM 17/1982; S. Thiago.

Schleich (1982) erwähnte erstmals Froschlurche von den Kapverden. Herr M. Tandy bestätigte die Zugehörigkeit der Kröten zu *Bufo regularis.* Von Angestellten des Landwirtschaftsministeriums der Kapverden (MDR) wurde versichert, daß die Kröten, bislang von S. Thiago und S. Nicolau bekannt, bereits zur Zeit der portugiesischen Kolonialherrschaft zur Dezimierung der Mückenplage in den öffentlichen Wasserreservoirs eingesetzt wurden.

5. Die einzelnen Inseln

Zu ihrer Geographie und Biologie-Ökologie der einzelnen Arten (s. a. Pkt. 2)

Verwendete Abkürzungen:

LT°C = Luft-Temperatur in °C
BT°C = Boden-(Substrat)-Temperatur in °C
KT°C = Körper-(Kloaken)-Temperatur in °C
LF % = relative Luftfeuchte in %

5.1 SAL

Sal, die südöstlichste, als einzig autonome Insel der Republik Cabo Verde hat eine Oberfläche von ca. 200 km² und eine maximale Höhe von 406 m. Die gestreckte, ca. 24 km lange und nur knapp 10 km breite Insel zeigt durch ihre geringen orographischen Unterschiede ein einheitliches Bild – eine monotone Steinwüste in typischer Serirausbildung geprägt. Gelegentliche Sanddünen, Bodenbildungen und Basaltberge wechseln das sonst eintönige Landschaftsbild.

Nur wenige größere Ribeiras und ebensowenige Oasen zeichnen sich ab.





Abb. 14: Sal; Straße nach St. Maria; Biotop von *Mabuya stangeri salensis* und *Hemidactylus bouvieri boavistensis.* – Abb. 15: Dünenlandschaft auf Boa Vista; Biotop von *Hemidactylus bouvieri boavistensis* und *Mabuya delalandii.* – Abb. 16: Im Inselinnern von Maio; Biotop von *Mabuya stangeri maioensis* und *Tarentola rudis maioensis.*

Artenspektrum

Nachgewiesen wurden: *Mabuya stangeri salensis, Hemidactylus brooki, Hemidactylus bouvieri boavistensis.* In der Geschichte der kapverdischen Herpetofaunistik wurden für Sal bereits 8 verschiedene Reptilienarten nachgewiesen, unter anderem auch eine Schlange, *Psammophis sibilans sibilans* durch DEKEYSER & VILLIERS (1951), die selbst aber berichteten, daß dieser einmalige Nachweis sicher auf eine anthropogene Verschleppung zurückzuführen ist (s. auch SCHLEICH 1982).

MERTENS konnte für Sal nur *Mabuya stangeri salensis* als einzigen Skink bestätigen. Das von ANGEL (1935, 1937) gemutmaßte Vorkommen von *Mabuya (stangeri) spinalis,* konnte von mir bislang nicht bestätigt werden. Die 9 Exemplare umfassende Kollektion an Skinken beinhaltet ebenfalls nur *Mabuya stangeri salensis.* Die Variationsbreiten ihrer Merkmalsausbildungen sind in den Diagrammen und in der Beschreibung (4.1.3.3) dargestellt. Leider gelang es mir auf keinem meiner insgesamt sechsmaligen Aufenthalte auf Sal eine *Tarentola* nachzuweisen.

Fundorte

1 ca. 3 km vor Palmeira: *Mabuya stangeri salensis*
2 Oase auf der Strecke nach St. Maria: *Mabuya stangeri salensis* und *Hemidactylus bouvieri bouvieri,* unter Palmenresten und Lesesteinen im Dünensand
3 Lagerhaus beim Flughafenhotel: *Hemidactylus brooki angulatus*
4 Steinwüste ca. 5 km südlich Flughafen: *Mabuya stangeri salensis*
5 Straße zur Saline (Pedra Lume): *Mabuya stangeri salensis, Hemidactylus bouvieri boavistensis*
6 Straße nach St. Maria: *Mabuya stangeri salensis, Hemidactylus bouvieri boavistensis*

Zur Biologie – Ökologie

Geländenotizen, Körpertemperaturen, Biotopcharakteristika:

16. 1. 81 – windig, bedeckt

Datum	Uhrzeit	LT °C	LF %	BT °C	Taxon	KT °C	Bemerkungen
16. 1.	14.00	24	–	30	*Mabuya*	29	unter Lavafels auf Sandboden
		28	45	28,5	*Mabuya*		(70 % LF, 23,5°C unter Stein); Boden leicht lehmig feucht
	14.45	–	–	–	*Mabuya*	26,5	(24°C unter Stein)
					Mabuya	25,0	
	15.00	22	–	29	*Mabuya*	30,0	(28°C unter Stein, semiadult)
	ab 20.00	–	–	–	*Hemid.*	24–26	Lagerhaus bei Hotel
	ab 24.00	–	–	22	*brooki*		
17. 2.					*Hemid. b. boav.*		kühl und windig, 7 Tiere gesichtet, Richtung Pedra Lume unter Steinen

Anmerkungen:

Bei einem Gespräch am 19. 9. 1977 auf Sal (St. Maria) mit Einheimischen bezüglich Reptilienvorkommen auf der Insel wurde mir einstimmig entgegnet, daß es auf Sal eigentlich gar nichts gibt, weder Pflanzen noch Echsen, und nur im Norden der Insel vereinzelt kleine Skinke vorkommen.

Zur Biologie der Echsen insbesondere von der zweitgrößten kapverdischen Mabuyenart *Mabuya stangeri salensis* ist bislang noch nichts bekannt.

Die Kotanalysen erbrachten folgendes Nahrungsspektrum für die im Januar gefangenen Mabuyen: Acridiidae, Curculionidae, Heteroptera, Myrmeleonidae, Tenebrionidae.

Für *Hemidactylus brooki angulatus* von den Lagerhallen des Flughafenhotels setzten sich die Rückstände wie folgt zusammen: Coleoptera, Tenebrionidae, Arachnidae, zahlreiche Blattaria und Orthoptera.

Für *Hemidactylus bouvieri boavistensis* ergaben die Rückstandsuntersuchungen folgende Zusammensetzung: Aranea, Tettigoniidae, Aphidina, Hymenoptera, Formicidae, Diptera, Coleoptera.

5.2 BOA VISTA

Boa Vista ist neben Sal und Maio eine der wüstenhaftesten bewohnten Inseln des Archipels, von rundlicher Form, ca. 620 qkm Flächenausdehnung und mit 390 m höchster Erhebung ebenfalls relativ flach. Der N-S-Mittelstreifen der Insel ist etwas gebirgiger und trennt die Bereiche der großen Sanddünen, die hauptsächlich auflandig der Westküste der Insel auftreten. Das typische Landschaftsbild der Insel sind vulkanische Gesteins- bzw. Gebirgsmassive mit Sanddünen, teilweise Sedimentgesteinen und Oasen- bzw. Ribeirabewirtschaftung.



Artenspektrum

Neben *Mabuya delalandii* (ZSM 373/78) wurde noch eine größere *Mabuya* gesichtet. Leider konnte das Tier nicht gefangen werden. An Geckos kamen noch *Tarentola* (nach Aussagen der Bevölkerung) und *Hemidactylus bouvieri boavistensis* (ZSM 366/78) vor. Leider gelang uns nur der Nachweis von letzterem!

Fundorte

1 Aufgrund verkehrstechnischer Verbindungsschwierigkeiten waren wir auf ein Sammelgebiet im Umkreis der Stadt Sal Rei beschränkt.
Steinwüste, Talalluvionen und Sanddünen beherrschen diesen Landschaftsabschnitt. Einzelne Lesesteine oder gestürzte Palmstämme bzw. kleine Pflanzeninseln auf den Sanddünen waren Unterschlupf und Zufluchtsraum für Skinke *(Mabuya delalandii, M. sp. indet.)* und Halbfingergeckos *(Hemidactylus bouvieri boavistensis).* Die Mauern der Straßeneinfriedungen waren ebenfalls beliebter Zufluchtsort der Skinke.

Zur Biologie – Ökologie

Geländenotizen:

Auf eine Fläche von ca. 1–2 qkm kamen etwa 1 Skink und ca. 3 Geckos. In einem ca. 4 qkm großen Areal wurden 15 Hemidactyli und 8 Mabuyen gefangen. Am 22. 7. 1977 entdeckte ich unter einem Palmstück 37 *Hemidactylus*-Eier, wovon zu diesem Zeitpunkt bereits etwa $^1/_3$ geschlüpft waren. Die Fluchtdistanz junger Mabuyen betrug ca. 15 m.

Sehr hell klingendes ,,Geckogekreische“ war in Gefangenschaftshaltung von 2 verbissenen *Hemidactyli* (? Streit, Kopula) sowohl am 9.3. als auch am 10.3.79 nachmittags zu hören. Weder vorher noch nach diesem Zeitraum war jemals wieder solch eine Lautäußerung vernommen worden. Am 9.3.79 wurde ein rundes, kleines hartschaliges Ei von etwa 2 g und 0,85 cm Durchmesser abgelegt.

Von Einheimischen wurde mir berichtet, daß eine größere Geckoart (? *Tarentola)* innerhalb der Häuser anzutreffen sei, leider glückte mir selbst der Nachweis bislang nicht.

An „natürlichen" Freßfeinden konnten wir hauptsächlich Katzen sehen.

5.3 MAIO

Maio gehört neben S. Thiago, Fogo, Brava und den Rhombos-Inseln ebenfalls noch zur Sotaventogruppe und hat mit die kleinste Einwohnerzahl aller kapverdischen Inseln. Maio ist von ovalem Umriß mit einer Flächenausdehnung von ca. 250 qkm und mit dem Mt. Renose im Inselzentrum, bis auf 436 m aufragend. Das Inselinnere ist relativ stark zergliedert. Tief eingeschnittene Ribeiras, Hochplateaus, Sandstrände und Kalkgesteinmassive wechseln mit Steinwüsten, Sanden, Talalluvionen und Vulkaniten im Landschaftsbild. Plattig absondernde Kalkschichten bieten mit ihren wie scherbenüberstreuten weiten Bodenflächen hervorragende Kleinstbiotope und Unterschlupf für Reptilien. Selbst auf den Salzklippen der Salinen waren Mabuyen zu finden.



Artenspektrum

Nachgewiesen wurden *Mabuya stangeri maioensis* sowie *Tarentola rudis maioensis.*

Fundorte

1 Ribeira zwischen Vila do Maio und Morro (19. 1. 81): *Mabuya, Tarentola*
2 Salinas: *Mabuya*

Zur Biologie-Ökologie

Die Populationsdichte in einem Biotopausschnitt von ca. 100 qm betrug etwa 30 Skinke und 10 Tarentolas, wobei meist 1–2 Skinke auf 1 Gecko unter einer Gesteinsplatte kamen.

Die Kotrückstandsuntersuchungen ergaben folgende Bestandteile für die Mabuyen:
Coreidae-Lygaeidae, Formicidae, Tenebrionidae
und für die Tarentolas:
Tettigoniidae, Blattaria, Cydnidae, Tenebrionidae, Acridiidae.

5.4 SAO THIAGO

S. Thiago (Santiagio, S. Jago) ist mit der Hauptstadt Praia flächenmäßig und der Einwohnerzahl nach die größte aller kapverdischen Inseln. Die Insel ist von tropfenförmigem Umriß mit einer Flä-

chenausdehnung von ca. 1000 qkm und reicht mit dem Pico da Antonia auf eine maximale Höhe von 1392 m. Landschaftlich, orographisch wie faunistisch und floristisch ist S. Thiago wohl die vielgestaltigste aller Cabo-Verde-Inseln. Die gesamte Insel ist relativ stark zerklüftet, mit tief einschneidenden Ribeiras, schroffen Vulkanschluchten und grünen Plantagen. Herpetologisch von Bedeutung war die kleine ehemalige Strafgefangeneninsel Ilhéu St. Maria in der Hafenbucht vor Praia mit ihren alten Ruinenmauern.

Artenspektrum

Bislang waren von S. Thiago an Skinken nur *Mabuya delalandii* (und *Mabuya stangeri)* bekannt, d. h. vor Mertens' Synonymisierung von *Mabuya vaillanti* mit *Mabuya delalandii* auch jene Art. Nach der Bearbeitung der Geckos (s. Pkt. 4.2) verbleiben für S. Thiago *Tarentola darwini* (Tarrafal), *Tarentola rudis rudis* und *Hemidactylus brooki angulatus.*

An Skinken verbleiben so der größte Kapverdische Skink (kreol.: Chinel) *Mabuya vaillanti* (ZSM 364/78), *Mabuya delalandii* (ZSM 363/78) und *Mabuya stangeri spinalis,* die meist sympatrisch einen Biotop besetzen.

Fundorte und Belege

1	Praia-Hafenstraße	:	*Mabuya delalandii, M. stangeri* *Tarentola rudis rudis*
2	Praia-Flughafen	:	*Mabuya delalandii* *Tarentola rudis rudis*
3	Cidade Velha	:	*Tarentola rudis rudis* *Mabuya delalandii*
4	S. Jorge dos Orgãos	:	*Bufo regularis*
5	Tarrafal	:	*Tarentola darwini* *Mabuya delalandii*
6	5 km von Tarrafal	:	*Mabuya vaillanti* *Mabuya delalandii* *Mabuya stangeri*
7	St. Cruz	:	*Mabuya vaillanti*
8	Ilhéu St. Maria	:	*Mabuya* spec. *Tarentola* spec.

Zur Biologie – Ökologie

Geländenotizen, Körpertemperaturen:

Die Messungen erfolgten kurz nach einem Regenschauer, alle Skinke wurden unter Steinen gefangen.

Datum	Uhrzeit	LT °C	LF %	BT °C	Taxon	KT °C	Bemerkungen
17. 1.	17.00	24,5	90	22	*M. del.*	24,5	teilweise noch aktiv
	17.15	25	90	23,5	*M. del.*	23,5	
	17.20	24,5	90	22,5	*M. del.*	23,5	
	17.25	24,5	90	22,5	*M. sta.*	25	leichter Regen
	17.50	21,5	–	21,5	*M. del.*	25 (2 ×)	Regen
	18.00	21	–	21,5	*M. del.*	23; 23,5; 25	
	21–21.30	20	–	20	*Tarentola*	23; 23; 22,5; 23,5	BT = Mauertemperatur
18. 1.	7.00	19	95	–	–		windig
	11.20	26,5	71	–	–		windig, Mabuyen aktiv



Auffallend ist die äußerst hohe Konzentration von *M. delalandii* im Bereich der Poussada Praia-Mar bis zur Hafenbucht. Sie erscheinen dort augenfällig als Kulturfolger und profitieren dabei aus den Fäkalien- und Abfallansammlungen am Straßenrand.

Interessant ist das Artenverhältnis in einem etwa 1 qkm großen Beobachtungsgebiet ca. 5 km südlich von Tarrafal, wo auf 2 adulte und 2 juvenile *Mabuya vaillanti* ca. 30 bis 50 *Mabuya stangeri* und einige hundert *Mabuya delalandii* kamen. In der Nähe von Praia ließe sich ein Verhältnis von etwa 100 *Mabuya delalandii* auf 10 *Mabuya stangeri* und 1 *Mabuya vaillanti* angeben. In Straßenunterführungen konzentrieren sich Geckos der Gattung *Tarentola*, die an Hauswänden nur seltenst anzutreffen sind, dafür diese aber öfters von einzelnen *Hemidactylus brooki angulatus* besetzt sind.

Interessante Beobachtungen glückten bei der erfolgreichen Nachzucht von *Mabuya vaillanti*. Als epigamische Reaktionen können ein hochfrequentes Vertikalnicken des Kopfes angesprochen werden, anschließend verbeißen die ♂♂ sich kurz in die ♀♀, um diese an der Flucht zu hindern, und dann zur Paarung einen Flankenbiß anzusetzen.

Bei Paarungsunwilligkeit des ♀ verbeißt dieses das ♂. Die Kopula erfolgt mit Flankenbiß. Sowohl kurz nach der Kopula als auch während dieser, kann das intervallartige hochfrequente Nicken während des Verbissenseins bei beiden Partnern anhalten. *Mabuya vaillanti* ist lebendgebärend. Die Größe der in Gefangenschaft mehrmals nachgezüchteten, neugeborenen Jungtiere betrug ca. 8 cm.

In Terrarienhaltung konnte beobachtet werden, daß *Mabuya vaillanti* meist omniphag, weniger *Mabuya delalandii*, und *Mabuya stangeri* nur noch carnivor war.

Die Kotanalyse getrockneter Exkrementrückstände von *Mabuya vaillanti* von St. Cruz ergab folgende Bestandteile: Acridiidae, Formicidae, Coleoptera, viele junge Blätter und Knospen möglicherweise von Cistaceae.

Die Nahrungsrückstände von *Mabuya delalandii* und *Mabuya stangeri* setzten sich wie folgt zusammen:

Heteroptera, Coreidae-Lygaeidae, Coleoptera, Tenebrionidae.

Bei den Tarentolas wurde getrennt nach den Formen von S. Thiago sowie nach jenen von Ilhéu St. Maria ausgewertet:

Praia: Aranea, Heteroptera, Cydnidae, Coreidae-Lygaeidae, Hymenoptera, Formicidae, Coleoptera, Tenebrionidae.

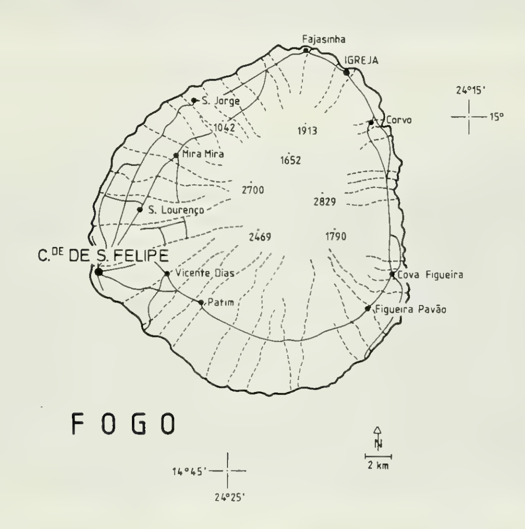
St. Maria: Acridiidae, Heteroptera, Cydnidae, Pentatomidae, Coreidae-Lygaeidae, Formicidae, Diptera, Tenebrionidae.

Freßfeinde

Sowohl auf S. Thiago wie auf Fogo konnten relativ viele Eisvögel *(Halcyon leucocephala acteon)* beobachtet werden. BANNERMAN & BANNERMAN (1968: 17) berichteten dazu: „... the kingfisher which tamely sits on the branches of the castor-oil plants and thence darts on grasshoppers and lizards."

5.5 FOGO

Fogo ist von rundlicher Gestalt und typischem Schichtvulkan-Habitus. Bis 2 829 m ragt der Pico de Fogo aus dem Meer, die Flächenausdehnung der Insel beträgt ca. 500 qkm, Hauptstadt ist S. Felipe. Der Pico, die große Caldeira, weite Lavafelder und tiefeingeschnittene Ribeiras kennzeichnen die Insel.



Artenspektrum

Obwohl *Mabuya vaillanti* aus der Aufsammlung des British Museum für Fogo (Igreja) bekannt war, gelang es mir nicht, diese Art nachzuweisen. Der geographisch höchste Nachweis eines Skinkes auf den Kapverden gelang auf dem Pico bei ca. 2 800 m. Leider wurde das Tier nur gesichtet, so daß seine Feldbestimmung als *Mabuya* cf. *fogoensis* unbestätigt bleibt. *Mabuya stangeri* kommt im offenen Gelände zusammen mit *Mabuya fogoensis* vor. *Hemidactylus brooki angulatus* wurde vornehmlich an Gemäuern in S. Felipe gefunden. *Tarentola rudis rudis* dagegen hauptsächlich im offenen Gelände, unter Wasserdurchlässen oder an freistehenden alten Häusern.

Fundorte

1	Pico de Fogo	:	*Mabuya* spec.
2	S. Felipe	:	*Mabuya, Tarentola, Hemidactylus*
3	3 km N-Mira Mira	:	*Mabuya*
4	S. Lourenço	:	*Tarentola*
5	Igreja	:	*M. vaillanti* (BMNH)

Zur Biologie – Ökologie

Geländenotizen, Körpertemperaturen:

Datum	Uhrzeit	LT °C	LF %	BT °C	Taxon	KT °C	Bemerkungen
26. 1.	7.00	20	90	–		–	S. Felipe
	21.45	24		24	*Hemidact.*	24	BT = Wand/Mauertemperatur
	22.30	23		23	*Hemidact.*	26	
	23.45	23		23	*Hemidact.*	26	zusammen unter Brücke
					Tarentola	26	
	24.00	22,5		22	*Tarentola*	23	
	22.35	19		20	*Tarentola*	21	S. Lourenço
		20		22	*Tarentola*	22	

Die Kotanalysen ergaben folgende Nahrungskomponenten:

Tarentola: Aphidina, Coleoptera, Tenebrionidae, Scarabaeidae, Tettigoniidae, Mantidae, Formicidae.

Hemidactylus: Isoptera, Formicidae, Diptera, Coleoptera.

5.6 BRAVA

Brava ist die südlichste Insel des Archipels und gehört noch zur Sotavento-Gruppe. Die Insel ist von rundlicher Gestalt bei einer Flächenausdehnung von ca. 65 qkm. Mit dem Monte Mato erreicht Brava 976 m über NN. Quellen, Wasserläufe, massives Kalkgestein und eine üppigere Vegetation geben der Insel ihr eigenes charakteristisches Aussehen.



Artenspektrum

Bislang waren von Brava (s. Schleich 1982: 246) *Mabuya delalandii, Mabuya stangeri, Tarentola delalandii (rudis)* sowie *Hemidactylus bouvieri bouvieri* und *Hemidactylus brooki angulatus* bekannt. Bei einem leider nur kurzen Aufenthalt konnten lediglich 8 *Mabuya delalandii* gefangen werden.

Fundorte

1 Forainhas bei Mato Grosso; vor dem Friedhof unter Lesesteinen: *Mabuya delalandii* (ZSM 370/78).



Abb. 17: Tarrafal-S. Thiago; Biotop von *Mabuya vaillanti, M. delalandii* und *M. stangeri.* – Abb. 18: Brava; Biotop von *Mabuya delalandii.* – Abb. 19: S. Vicente; Biotop von *Tarentola caboverdiana substituta* im Inselinnern.

Geländenotizen:

Am 29.7.1977 wurden auf einer Ackerbaufläche von ca. 250–300 qm unter Lesesteinen 8 Skinke gefangen.

5.7 ILHÉUS DO RHOMBO

Die nahe vor Brava liegenden Ilhéus do Rhombo sind unbewohnte Felseilande, deren drei größte Inseln Luz Carneiro, Sapado Grande und Cima sind. Mit 96 m erreichen sie auf Ilheu Grande die höchste Erhebung.

Leider konnten die Inseln von mir selbst nie besucht werden. Schleich (1982: 246) gibt nach Mertens und Angel *Mabuya delalandii, Mabuya vaillanti, Tarentola delalandii = (T. rudis)* und *Hemidactylus brooki angulatus* an. Joger (1984: 101) führt auch „*Tarentola borneensis protogigas*" *(= T. rudis protogigas)* an.

ILHÉUS SECOS
OU DO ROMBO
ILHÉU GRANDE
96·
ILHÉU LUZ
CARNEIRO
ILHÉU DE CIMA
N
1 km
14°55'
24°43'

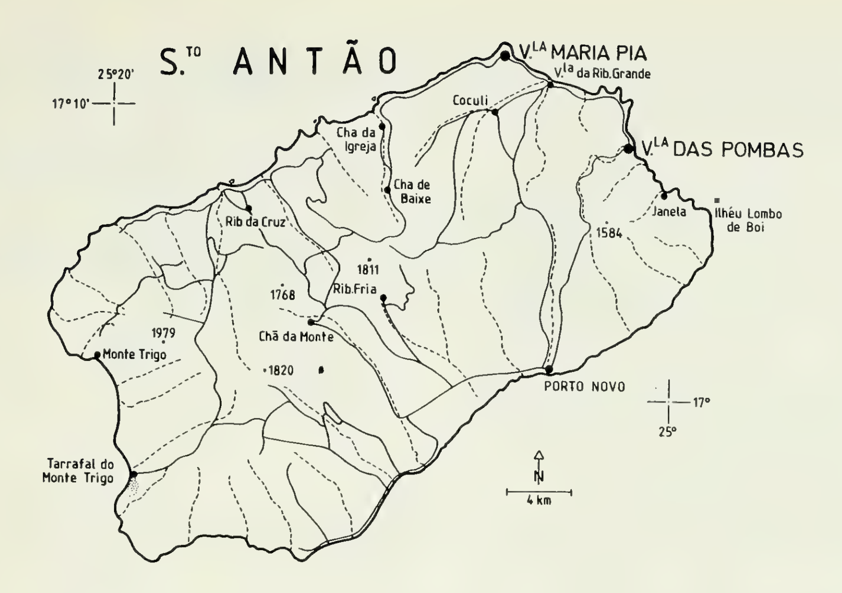
5.8 SANTO ANTÃO

Santo Antão, die nordwestlichste der kapverdischen Inseln, zählt neben S. Vicente, den Islas Desertas, S. Nicolau, Sal und Boa Vista zur Gruppe der Barlaventos.

Die Insel besitzt annähernd rechteckige Grundform bei einer Fläche von 730 qkm. Santo Antão ist auch in extremsten Trockenperioden neben S. Thiago und Brava eine der Inseln mit ständig offenen Fließwässern. St. Antão ist die gebirgigste, zerklüftetste und landschaftlich beeindruckendste aller Inseln. Die Südostseite ist bis zu dem längs über die Insel ziehenden Gebirgskamm trocken, steinig und von wüstenartigem Gepräge. Die NW-Seite dagegen zeichnet sich durch üppig grüne Landschaften mit steilen Felswänden, Tälern und überraschender Fruchtbarkeit aus.

Artenspektrum

Erst der zweite Besuch auf St. Antão war bezüglich des Reptilienfanges erfolgreich. Wir suchten auf der trockenen SE-Seite der Insel erfolgreich, wogegen auf der NW-Seite im Bereich von Ribeira-Grande weder Geckos noch Skinke zu finden waren. Einheimische meinten, daß es hier keine Echsen, insbesondere Geckos mehr gäbe, da sie von den erst vor kurzem durch Saatkartoffeln aus Kontinentalafrika eingeschleppten Skolopendern „aufgefressen" worden wären. Leider glückte auch hier kein Nachweis von *Hemidactylus bouvieri bouvieri* (s. Schleich, 1982: 246), dagegen von *Mabuya fogoensis antaoensis* und *Tarentola caboverdiana caboverdiana* ca. 4 bis 10 km nördlich der Straße von Porto Novo nach Chã da Monte.



Fundorte

1 Gebiet ca. 4–10 km nördl. der Straße von Porto Novo nach Chã da Monte: *Mabuya fogoensis antaoensis*, *Tarentola caboverdiana caboverdiana.*

Zur Biologie – Ökologie

Geländenotizen:

Am 24. 9. 81 konnten wir nachmittags im beschriebenen Areal bei einer LT von ca. 28–40°C aktive Mabuyen und Tarentolas unter Lesesteinen fangen. Auffallend war dabei ein großer Anteil diesjähriger Jungtiere, der auch zu dieser Zeit auf allen anderen Inseln bemerkt wurde.

5.9 SAO VICENTE

Sao Vicente liegt im NW des Archipels zwischen St. Antão und den Islas Desertas. Mit der Ilha do Sal ist Sao Vicente als eine der wüstenhaftesten des Archipels zu bezeichnen. Die Insel ist von rundlich-rautenförmiger Gestalt und hat eine Gesamtausdehnung von ca. 220 qkm bei einer maximalen Höhe



von 774 m mit dem Monte Verde. Große Gebirgszüge, weite öde Wüstenstrecken und junge, von vulkanischer Aktivität gezeichnete weite Lavagebiete sowie Dünengürtel kennzeichnen die Insel.

Artenspektrum

In einer früheren Arbeit (Schleich 1982: 246) erwähnte ich nach verschiedenen Autoren *Mabuya fogoensis* und *Mabuya stangeri*, die ich vorbehaltlich noch als *Mabuya* spp. indet. ansprach und nach der systematischen Überarbeitung als zu *Mabuya stangeri stangeri* gehörig betrachte.

An Geckos wurde „*Tarentola delalandii*" als *Tarentola caboverdiana substituta* (s. Pkt. 4.2.3.4) berichtet, *Hemidactylus brooki angulatus* nachgewiesen und *Hemidactylus bouvieri bouvieri* durch zwei Exemplare aus dem British Museum (Gruber & Schleich 1982) belegt.

Fundorte

1 Küstenabschnitt südl. von Madeiral:
Mabuya stangeri stangeri
2 ca. 3 km westl. von Madeiral:
Tarentola caboverdiana substituta
3 Häuserfront der Hafenstadt Mindelho:
Hemidactylus brooki angulatus

Anmerkung: Weite Bereiche der Insel wurden neben den genannten Fundpunkten abgesucht, jedoch ohne Erfolg.

Zur Biologie – Ökologie

Geländenotizen:

Der Biotop (Fundpunkt „2") der am 4. 8. 77 gefangenen Tarentolas bestand in einer im Umkreis weniger qkm vegetationslosen Sand-Stein-Wüste, wo unter einzelnen, wenigen Lesesteinen meist 2 Tarentolas zu finden waren. Skinke wurden hier keine gesehen. Etwa 2 km westlich von Punkt 2 konnten zwei vereinzelte Jungtiere von *Mabuya stangeri stangeri* gefangen werden. Im gesamten Bereich zwischen Mindelho und S. Pedro wurde intensivst gesucht, jedoch ohne einen einzigen Nachweis erbringen zu können.

Für *Tarentola caboverdiana substituta* erbrachte die Analyse der Kotproben folgende Zusammensetzung:

Zahlreiche Cydnidae, viele Coreidae-Lygaeidae und Coleoptera sowie Pentatomidae, Tettigoniidae, Scarabaeidae, eine Spinne (Aranea) sowie eine Lepidopteren-Larve und drei Geckoschwanzenden.

5.10 ST. LUZIA

In Schleich & Wuttke (1983) wurden die Islas Desertas mit St. Luzia, Branco und Razo gesondert abgehandelt, so daß eine detaillierte Wiederholung hier entbehrt werden kann. Weitere Angaben zu den Islas Desertas finden sich bei Schleich (1977, 1980 und 1982) und Gruber & Schleich (1982).



Artenspektrum

Nach einem längeren Aufenthalt und intensiven Begehungen und Suchaktionen konnte lediglich *Mabuya stangeri stangeri* und *Tarentola caboverdiana raziana* nachgewiesen werden.

Fundorte

Gesammelt wurde auf der ganzen Insel, vornehmlich im Bereich des Mittelteiles.

Zur Biologie – Ökologie

Geländenotizen, Körpertemperaturen:

Datum	Uhrzeit	LT °C	LF %	BT °C	Taxon	KT °C	Bemerkungen
2. 2. 81	11.40	22,5	–	31,0	*Tarentola*	29,0	windig, ca. 300 m NN auf windexponiertem ungeschütztem Felsgrat T°C unter Stein: 21,5°C, auf Stein: 26,5°C
		22,5		29,0	*Tarentola*	25,5	
	11.40	22,5		29,0	*Tarentola*	27	T°C unter Stein: 19°C
		22,5		29	*Mabuya*	28	
		22,5		29	*Mabuya*	26,5	
	13.00	22		32,5	*Mabuya*	30	adultes Tier
	.20	22		33,5	*Mabuya*	30	adultes Tier, sehr windig, sonnig
	14.25	22		33	*Tarentola*	28,5	26°C unter Stein
					Tarentola	29,5	adultes Tier
	14.45	22,5		33	*Tarentola*	31,5	♀ mit 1 Ei (Schatten – T°C)
		26,5		33,5	*Tarentola*	–	(Sonne – T°C)
	14.55			32		31	♀ mit 1 Ei
						27,5	♂, T°C unter Steinplatte: 28°C Hemipenes beim Messen ausgestülpt
	15.00	23,5		32,5		31	♀ mit Ei
	15.10	25		35	*Mabuya*	28,5	Adulti, unter Steinplatte eingegraben (BT unter Platte: 26°C)
	15.30	24		32	*Mabuya*	30,5	aktiv, semiadult
	21.20	21		20	*Tarentola*	20	
	21.45	19		18	*Tarentola*	19	19°C unter Steinplatte
3. 2.	13.30				*Tarentola*	27	25°C in ca. 20 cm „Bautiefe"
	24.00	19	82				
4. 2.	6.30	17					Sonnenaufgang
5. 2.	7.00	17	82				
	9.00	24	65				

5.11 BRANCO

Branco, die mittlere der 3 Islas Desertas, ist an einigen Sandbuchten von der SW-Seite aus anlandbar. Detaillierte Informationen zur Inselbeschreibung finden sich bei Schleich & Wuttke (1983) sowie bei Schleich (1979, 1980).

Artenspektrum

Mehrere längere Aufenthalte auf Branco bestätigten lediglich 2 Echsenarten: *Tarentola gigas brancoensis* und *Mabuya stangeri stangeri.* Ein frisches Gelege einer Seeschildkröte konnte im Sommer 1977 entdeckt werden. Nach Schleich (1982) gilt *Macroscincus* als ausgestorben.

Fundorte

Gesammelt wurde auf der ganzen Insel, jedoch konzentrieren sich die Riesengeckos auf den mittleren Bereich im



SW der Insel. Detaillierte Angaben zur Struktur, Fauna und Flora der Insel s. SCHLEICH (1980) u. SCHLEICH & WUTTKE (1983).

Zur Biologie – Ökologie

Geländenotizen, Körpertemperaturen:

Datum	Uhrzeit	LT °C	LF %	BT °C	Taxon	KT °C	Bemerkungen
6. 1. 81	12.20	22	86	32	*Tarentola*	24,5	ausgegraben, ca. 80 cm tief in Sandhöhle (T°C: 25)
	14.45	23	–	23	*Mabuya*	29	ca. 20 m NN, Steilhang N-Seite
	17.05	22	–	25	*Mabuya*	28	(T°C unter Steinplatte: 28) in ca. 40 cm Bautiefe: 86 % LF; 22°C

5.12 RAZO

Eine detaillierte Beschreibung zu Razo findet sich bei SCHLEICH & WUTTKE (1983).

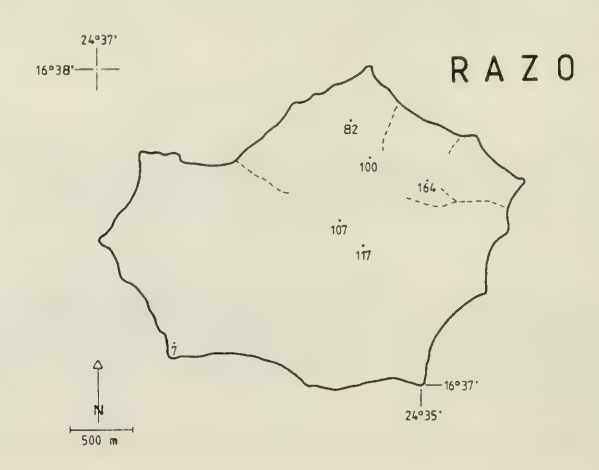




Abb. 20: Blick auf Branco; deutlich sind die Sanddünen – das Hauptverbreitungsgebiet von *Tarentola gigas brancoensis* – zu erkennen. Im Hintergrund rechts: St. Luzia. Im Vordergrund Razo mit dem Biotop von *Hemidactylus bouvieri razoensis, Tarentola gigas gigas* und *Mabuya stangeri stangeri.*



Abb. 21: Bereich im Innern von St. Luzia, der Biotop von *Tarentola caboverdiana raziana* und *Mabuya stangeri stangeri.*

Artenspektrum

Razo wurde von meinen Begleitern und mir in den letzten Jahren gründlich herpetologisch durchforscht, wobei folgende Taxa studiert wurden:

Tarentola gigas gigas
Tarentola caboverdiana raziana
Mabuya stangeri stangeri
Hemidactylus bouvieri razoensis

Fundorte

Gesammelt wurde auf der ganzen Insel, jedoch scheinen außer *Mabuya* die übrigen Arten auf bestimmte Inselabschnitte gebunden zu sein oder zumindest sich dort zu konzentrieren (s. SCHLEICH & WUTTKE 1983).

Zur Biologie – Ökologie

Geländenotizen, Körpertemperaturen:

Datum	Uhrzeit	LT °C	BT °C	Taxon	KT °C	Bemerkungen
10. 2. 81	15.30	22	27,5	*Mabuya*	27,5	aktiv
	19.00	21		*Tarentola*	21	

Zur Biologie von *Hemidactylus bouvieri razoensis* Gruber & Schleich wurde 1982 gesondert berichtet; eine detaillierte Sammeldarstellung zu *Tarentola gigas* ist in Vorbereitung. Weitere Angaben sind aus Schleich & Wuttke (1983) zu entnehmen.

Die Kotanalyse erbrachte folgendes Nahrungsspektrum für

Mabuya:
Acridiidae, Tettigoniidae, Cydnidae, Pentatomidae, Coreidae-Lygaeidae, Formicidae, Coleoptera, Tenebrionidae

Tarentola caboverdiana raziana:
Opiliones, Acridiidae, Cercopidae, Heteroptera, Pentatomidae, Diptera, Coleoptera, Tenebrionidae, pflanzliche Reste

Tarentola gigas gigas:
Opiliones, Tettigoniidae, Mantidae, Formicidae, Coleoptera, Tenebrionidae, Carabidae.

5.13 S. NICOLAU

S. Nicolau, zu den Barlaventos gehörend, hat eine Flächenerstreckung von 350 qkm bei einer maximalen Höhe von 1304 m. Ähnlich St. Antão ist auch hier eine fast lineare landschaftsklimatologische Zweigliederung der Insel in den sehr trockenen Südteil und den vegetationsreicheren Nordteil zu erkennen, wo in letzterem auch vorwiegend die Reptilien gefangen werden konnten.



Artenspektrum

Mabuya fogoensis und *Tarentola caboverdiana nicolauensis* scheinen hier als einzige Arten neben *Bufo regularis* vorzukommen.

Fundorte

1 Ribeira Brava: *Bufo regularis*
2 Etwa halbe Strecke zwischen Preguiça und Rib. Brava: *Tarentola, Mabuya*

Zur Biologie – Ökologie

Geländenotizen:

1977 konnten bei den offenen Wasserbecken der Quellfassung von Ribeira Brava ca. 100 Kröten gezählt werden, wovon 1981 nach Verbauung der Quelle nur noch wenige einzelne Tiere vorhanden waren.

Die Kotanalyse erbrachte folgendes Nahrungsspektrum für

Mabuya: Cercopidae, Heteroptera, Coreidae-Lygaeidae, Formicidae, Coleoptera, Carabidae, pflanzl. Reste

Tarentola: Aranea, Cydnidae, Heteroptera, Coreidae-Lygaeidae, Formicidae, Coleoptera, Curculionidae.

Die Tiere wurden am 20. 7. 81 gefangen.

6. Biotop- und Artenschutz

Bannerman & Bannerman (1968) wiesen wohl als erste auf einen dringend notwendigen Artenschutz der kapverdischen Fauna hin. Ihr Bericht (op. cit., S. 5) über die „laws for the protection of nature" basiert verständlicherweise noch auf den Angaben aus der portugiesischen Kolonialzeit mit Gesetzen von 1955. Aus Bannerman & Bannerman (op. cit.) sei zitiert:

„Here is a list of the birds that cannot be killed in the Archipelago, it being true that the only other animal whose life is safeguarded by law is the skink *Macroscincus coctei:* most of the species of swifts, larks, flamingos *(Phoenicopterus ruber)* and the cattle egret *(Ardeola ibis).*

The following species can only be hunted during the game season from 1st December to 31st July: rock-pigeon *Columba livia,* the quail *Coturnix coturnix,* and the guinea-fowl *Numida galeata.*"

Von weiteren Bedrohungen bzw. Ausrottungen berichten Bannerman & Bannerman (op. cit., S. 42).

Jedoch wiesen bereits viele Autoren schon kurz nach der Erstbeschreibung von *Macroscincus coctei* auf dessen Schutzwürdigkeit bzw. bevorstehende Ausrottung (s. Schleich 1979) hin.

In gleicher Weise sprach ich bereits von einer dringlichen Notwendigkeit eines Schildkrötenschutzprojektes.

Schleich & Wuttke (1983: 41) müssen leider von intensivsten Nachstellungen der Avifauna auf den kleinen unbewohnten Inseln Branco und Razo berichten, denen sicher auch die Ausrottung von *Macroscincus coctei* anzulasten ist.

Als dringlich erachte ich in Zusammenarbeit mit der kapverdischen Regierung die Erstellung von Arten- bzw. Biotopschutzprogrammen für folgende Reptilien:

Cheloniidae spp.
Mabuya vaillanti
Tarentola gigas ssp.
Hemidactylus bouvieri razoensis

Ein umfassender zusätzlicher Biotopschutz, insbesondere der unbewohnten Inseln Branco und Razo (möglicherweise auch der Rhombos-Inseln, jedoch liegen mir hier keine persönlichen Aufzeichnungen vor), würde nicht nur deren Herpetofauna, sondern auch die Avifauna schützen! Entscheidend scheint mir dabei, die beiden Inseln überhaupt vor unkontrolliertem Betreten zu schützen, um nicht Mäuse und Ratten einzuschleppen. Auf St. Luzia (s. Schleich & Wuttke 1983) können die Mäuse bereits als richtige Plage bezeichnet werden, die sicher auch für den niedrigen Reptilienbesatz auf dieser unbewohnten Insel verantwortlich sind.

Ein detailliertes Aufklärungsprogramm über sinnvolle Nutzung und Schutz sowohl der Herpetofauna als auch der Avifauna scheint mir unabdingbar.

Nachtrag: Nach Fertigstellung des Manuskripts erfolgte von IUCN/WWF erfreulicherweise die Herausgabe von Ersttagsbriefen, -karten mit englischem und deutschem Begleittext zu den schutzbedürftigsten Arten kapverdischer Reptilien. Hierzu sind *Tarentola g. gigas, T. g. brancoensis, Hemidactylus bouvieri razoensis* und *Mabuya vaillanti* abgebildet auf 4 verschiedenen Briefmarken der Republik Cabo Verde unter dem Titel „Proteção de Espécies em Via de Extinção" erschienen.

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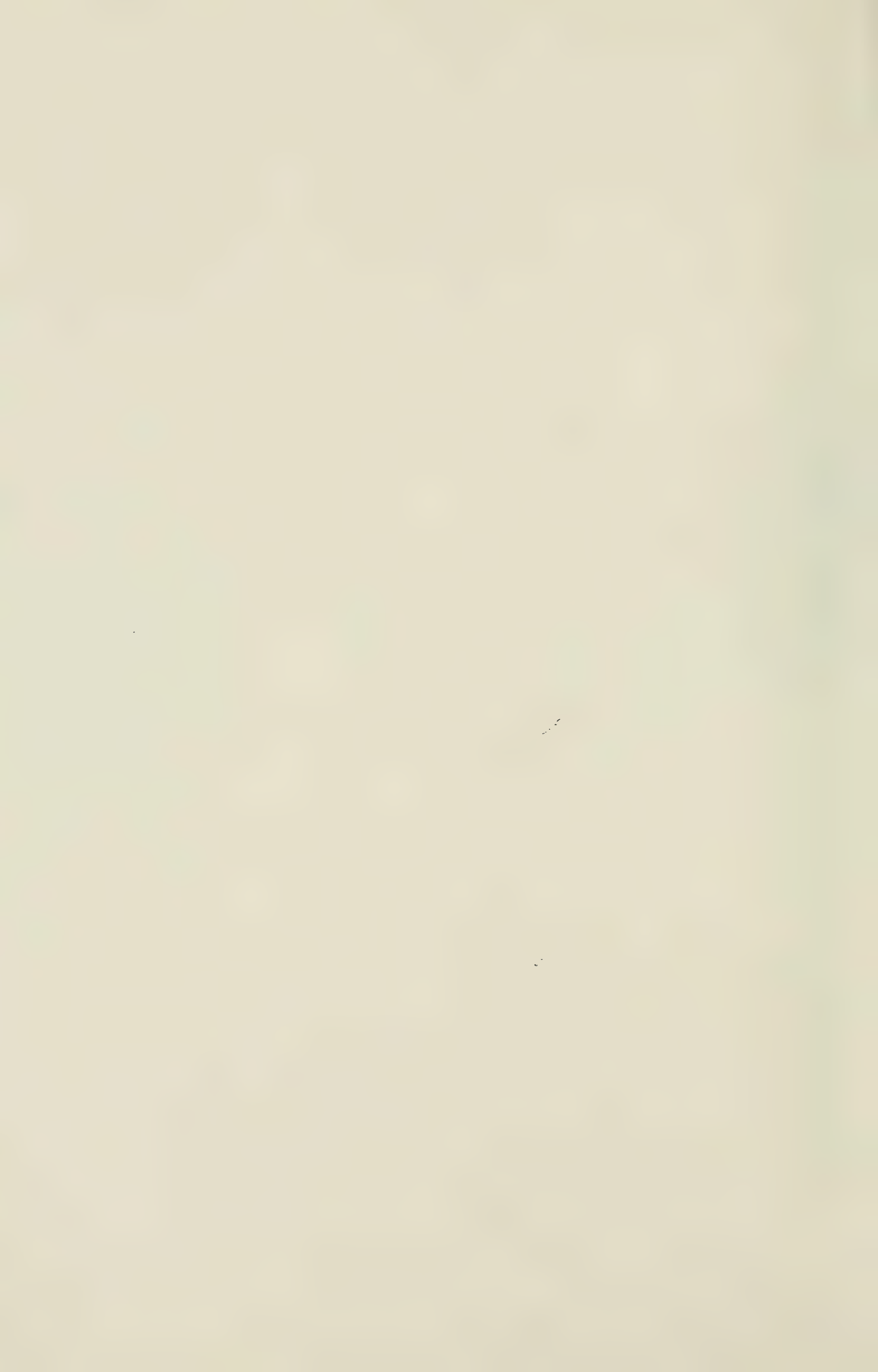
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A Revision of the Holarctic Species of Orthocladius (Euorthocladius)

(Diptera: Chironomidae)

By Annelle R. Soponis

Herausgegeben
von
E. J. Fittkau

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Contents

Abstract:

The classification of the Holarctic species of the subgenus *Orthocladius (Euorthocladius)* is revised. Keys to species for adult males, pupae, and larvae are given. Keys to subgenera of *Orthocladius* are included for adult males, pupae, and larvae. Fifteen names of *Orthocladius (Euorthocladius)* are recognized as valid. Redescriptions or notes on previously-known species and descriptions of three new species are presented. The new species are: *ashei, coffmani,* and *roussellae.* Type Material was examined for the following species: *abiskoensis, anteilis, calvus, difficilis,*

kanii, luteipes, saxosus, suspensus, telochaetus, and *thienemanni.* Lectotypes are designated for *abiskoensis* Thienemann and Krüger, *rivulorum* Kieffer, and for the type of the subgenus, *thienemanni* Kieffer. The type of *rivicola* Kieffer could not be located.

Introduction

Adults of *Orthocladius (Euorthocladius)* are small to medium-sized, yellow, green, brown, or black chironomids. In the temperate zone they emerge primarily in spring, fall and winter, although some are taken at high altitudes and latitudes in summer.

Live larvae have brown head capsules and green, brown, or yellow bodies, and live in gelatinous tubes in cold springs or fast-flowing waters of inlets, creeks, streams, and rivers. These gelatinous tubes are initially clear, and can be covered with sand or algae, appearing brown or green depending on the habitat. In the *rivicola*-group, larvae live in ellipsoid tubes fastened along their margins to stones and rocks. In some species, e. g. *saxosus* and *thienemanni,* larvae are gregarious. In the *rivulorum*-group, larvae live in suspended tubes, attached by one end to stones and rocks. Larvae of certain species have been collected from moss *(ashei, abiskoensis, rivolorum),* reeds *(thienemanni), Ranunculus (ashei),* and algal mats *(roussellae).* Larvae collected from mud have probably occured there accidentally.

Species of *Orthocladius (Euorthocladius)* can be sympatric ands synchronous, and it is not unusual to collect exuviae of different species, e. g. *rivicola* with either *ashei, luteipes,* or *thienemanni,* in the same sample.

Based primarily on pupal characters, the species can be placed in one of two groups: the *rivicola*-group *(ashei, calvus, difficilis, kanii, luteipes, rivicola, thienemanni);* and the *rivulorum*-group *(anteilis, coffmani, rivulorum, roussellae, suspensus).* The species *abiskoensis* and *saxosus* share characteristics of both groups.

Characters separating species can be very subtle, and several species remain undescribed. Intraspecific variation is apparently large, and needs to be studied further. Three species found in Japan are almost identical morphologically to certain species from Europe and/or North America, but because of important morphological differences in the pupa or adult male, the incipient species in the subgenus, and the lack of series of reared specimens, these species are not synonymized here: *suspensus* and *rivulorum, kanii* and *luteipes,* and *saxosus* and *telochaetus.*

Although names of *Orthocladius (Euorthocladius)* have appeared often in the literature, actual museum specimens are few, given the number of species. Whether this reflects low abundances or inadequate collecting of natural populations remains unanswered.

The subgenus *Orthocladius (Euorthocladius)* is recorded only from the Holarctic Region. Because the genus *Orthocladius* is distributed worldwide (Soponis 1977), it would not be surprising to find species of *Orthocladius (Euorthocladius)* in other regions of the world in cold or fast-flowing waters.

Species of O. *(Euorthocladius)* are most easily identified in the pupal stage. Specific identification of adult males is particularly difficult because of intraspecific variation and morphological similarity of congeners. Specific identifications of larvae can be made with more confidence than of adult males, but for accurate specific identification larvae should be associated with the pupal stage.

Prior to the present study, six species of *Orthocladius (Euorthocladius)* were recorded from the Palearctic region (Sasa & Yamamoto 1977, Fittkau & Reiss 1978) and two species from the Nearctic region (Sublette & Sublette 1965). Presently ten species are reported from the Nearctic region and nine species from the Palearctic region, with six species occuring in both regions. There has been uncertainty about whether or not to place *frigidus* and *abiskoensis* in the subgenus O. *(Euorthocladius). Orthocladius frigidus* belongs to *Orthocladius (Orthocladius).* (Soponis, 1987), and *Orthocladius abiskoensis* has been placed in O. *(Euorthocladius)* by Säwedal (1978), which is accepted here.

The primary objective of this study was to revise the classification of the Holarctic species of *Orthocladius (Euorthocladius)*, thereby gaining a better understanding of the genus *Orthocladius*. Adult males of *Orthocladius* are difficult to place to subgenus, but pupae and larvae can be assigned with relative ease. Adult males and larvae of *Orthocladius* are difficult and sometimes impossible to place to species, but pupae can be determined to species with relative ease.

The following keys should be considered tentative; the most accurate specific identifications of *Orthocladius (Euorthocladius)* will be those based on specimens associated with the pupal stage. Caution must be used in identifying Palearctic material since the species-rich *Orthocladius (Orthocladius)* of the Palearctic still needs revision.

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It is my pleasure to thank all those who contributed to this project over the years, and I apologize for any omissions: W. P. Coffman for testing the pupal key; P. S. Cranston for helping with literature and types; J. H. Epler for discussing systematic problems; E. J. Fittkau for providing the opportunity to publish; R. W. Flowers for translating Tokunaga 1964; P. Grootaert for facilitating loans of the Goetghebuer types; L. C. V. Pinder for providing an early version of the *Orthocladius calvus* manuscript; F. Reiss for facilitating access to the ZSM collection and the Thienemann types and notebooks; and, J. E. Sublette for supplying photographs of *Orthocladius anteilis*.

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BMNH	British Museum (Natural History), London, P. S. Cranston
BRUX	Institut Royal des Sciences Naturelles de Belgique, Bruxelles, P. Grootaert; also R. I. Sc. NB.
CALD	B. A. Caldwell, Stone Mountain, Georgia
CNC	Canadian National Collection, Ottawa, D. R. Oliver
COFF	W. P. Coffman, Pittsburgh, Pennsylvania
DUB	University College, Dublin, Ireland, P. Ashe, D. Murray
FBA	Freshwater Biological Association, England, L. C. V. Pinder
FDER	Florida Department of Environment, Punta Gorda, A. S. Walton, Jr.
FSCA	Florida State Collection of Arthropods, Tallahassee
FWI	Freshwater Institute, Winnipeg, Canada, B. Bilyj
GUTH	P. Guthrie, Gainesville, Florida
HEY	M. W. Heyn, Columbus, Georgia
HUD	P. L. Hudson, Ann Arbor, Michigan
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MAS	P. Mason, Regina, Canada
MINN	University of Minnesota, St. Paul, E. F. Cook, P. J. Clausen
NAT	N. Natchev, Bistriza, Bulgaria
NCNR	North Carolina Department of Natural Resources, Raleigh, D. R. Lenat
NMI	National Museum of Ireland, Dublin
NYSH	New York State Department of Health, Albany, K. W. Simpson
OSU	Oregon State University, Corvallis, J. Furnish
ROSS	B. Rossaro, Milan, Italy
SBSK	State Biological Survey of Kansas, Lawrence, L. C. Ferrington, Jr.
SUB	J. E. Sublette, Pueblo, Colorado
UCOP	University of Copenhagen, C. Lindegaard

USGS	United States Geological Survey, Atlanta and Tucson, B. Steiner, J. Doughman
USNM	United States National Museum, Washington, D. C., W. W. Wirth, R. V. Peterson
YAM	M. Yamamoto, Fukuoka, Japan
ZMB	Zoological Museum Bergen, Norway, O. A. Saether, G. Halvorsen
ZSM	Zoologische Staatssammlung, Munich, West Germany, F. Reiss, E. J. Fittkau

Materials and Methods

This study was based on an examination of approximately 700 specimens, representing 15 species of *Orthocladius (Euorthocladius).* Type material was remounted in Canada balsam after treating the specimen in sequential baths of 10% potassium hydroxide (KOH), distilled water, glacial acetic acid, 2-propanol, and 2-propanol-cedarwood oil (Oliver & Roussel 1983). Specimens stored for long periods in alcohol dehydrate and fade. Maceration ("clearing") of the internal tissues is often impossible to accomplish without simultaneously making the exoskeleton invisible. Using cold 2% KOH for a longer time rather than hot 10% KOH briefly macerates tissue while maintaining specimens in better condition. Euparal appears to cause more collapse of structures than balsam. Although balsam may be considered the choice for mounting museum specimens, Hoyer's may be a better alternative for teneral and problem specimens. Handling specimens through successive dehydrations and chemical treatments is avoided with the use of Hoyer's.

For the most part, terminology follows Saether (1980). Figures, counts, and measurements are my own, and follow Soponis (1977). In adult males of *Orthocladius,* two kinds of eyes can be distinguished: those with typically, slightly extended medial margins, here called male-like (Fig. 12), and those with widely separated medial margins, here called female-like (Fig. 13). The entire length of the leg was measured, rather than the median axis (cf. Schlee 1968). Since *Orthocladius* adults do not have prominent tibial extensions as do adults of, e.g. *Corynoneura,* there is no advantage in measuring along the median axis. In adult males, AW is the antepronotal width measured medially.

Here, cast-off pupal skin(s) is/are referred to as exuviae (Ex) as recommended by Langton (1984). A cast off larval skin is referred to as a larval skin (LS).

Only the fourth larval instar was studied, unless otherwise indicated. For the larvae the mental ratio (MR) (Soponis 1987) is used: width of the median tooth/width of first lateral tooth of the mentum.

Other standard ratios used are:

AR – (male, – antennal ratio (Edwards 1929): length of last flagellomere/total length of flagellomeres 1–12
AR – (larva – antennal ratio (Fittkau 1962, modified by Schlee 1966): length of basal segment/total length of terminal segments
LR – leg ratio (Edwards 1929): length of first tarsal segment/length of tibia
HR – hypopygium ratio (Saether 1968): length of gonocoxite/length of gonostylus

The Subgenus Orthocladius (Euorthocladius)

Euorthocladius Thienemann, 1935; 1944.
Spaniotoma (Orthocladius) group *Euorthocladius*. Johannsen, 1937.
Orthocladius (Orthocladius) [partim]. Andersen, 1937. Goetghebuer, 1942.
Hydrobaenus (Bryophaenocladius) [partim]. Kloet & Hincks, 1945.
Orthocladius van der Wulp [partim]. Chernovskii, 1949. Sublette & Sublette, 1965. Pankratova, 1970. Sasa & Yamamoto, 1977. Oliver, 1981.
Orthocladius (Euorthocladius). Brundin, 1956. Fittkau et al., 1967. Hamilton et al., 1969. Kloet & Hincks, 1975. Soponis, 1977. Fittkau & Reiss, 1978. Pinder, 1978. Cranston, 1982. Ashe, 1983. Cranston et al., 1983. Oliver & Roussel, 1983. Coffman & Ferrington, 1984.
Hydrobaenus group *Euorthocladius*. Roback, 1957a.
Hydrobaenus Fries [partim]. Wirth & Stone, 1968. Cole, 1969.
?*Lapporthocladius* Thienemann. Brundin, 1956.
Lapporthocladius Thienemann. Säwedal, 1978.

Type of Subgenus: *Orthocladius thienemanni* Kieffer, designated by Thienemann, 1935: 201.

Diagnosis

Adult males and immature stages of *Orthocladius (Euorthocladius)* resemble those of the other subgenera of *Orthocladius*. Most adult males of *Orthocladius (Euorthocladius)* can be distinguished by the multiserial scutellars and the rounded anal point. If the scutellars are uniserial, then the female-like eyes will distinguish most males of *Orthocladius (Euorthocladius)*.

Pupae of O. *(Euorthocladius)* can be distinguished by the lack of anal macrosetae.

Larvae of O. *(Euorthocladius)*, except for *rivulorum*, can be distinguished by the brown head capsule, 5-segmented antenna, robust Lauterborn organs, sparse chaetulae laterales, shortened teeth of the mandible, and 13 to 15 teeth on the mentum.

Description

Adult Male

Small, medium or large chironomids. Yellow, green, brown, or black. Head. Eyes widely separated; temporals uniserial except in *roussellae*, doubled or clumped near the coronal suture. Postorbitals present except in *suspensus* and some *rivulorum*. AR usually 1.00−2.15 (0.80 recorded for alpine *rivicola*). Palps normal to long, with segment 3≥4, except in *anteilis*, *suspensus*, and *thienemanni*, segment 3<4. Thorax. Antepronotal lobes weak to robust, wide or narrow medially. Lateral antepronotals present; acrostichals present or absent within and between species; prealars present; dorsocentrals uniserial except in some *roussellae*, biserial; scutellars usually biserial or multiserial, except in some *rivicola* and some *abiskoensis*, uniserial. Mesonotal pit usually absent; if present, weakly developed. Wings. Length 1.30−3.45 mm. Finely to moderately punctate with anal lobe right-angled, or slightly to strongly produced. VR 1.00−1.22. Brachiolum with 1−2 setae, R with 2−12, squama with 8−40. R4+5 bare except in single specimens of *abiskoensis*, *calvus*, *roussellae*, and *telochaetus*. Costa ending above or distal to M3+4. R2+3 ending about $^1/_3$ the distance between R1 and R4+5. Legs. Hind tibial comb composed of 6−13 setae. Tarsal spines absent on p1; 2 spines usually present on ta1 and ta2 of p2 and p3. Tarsal beard present on p3. LR1 0.57−0.77 (0.80 recorded for *saxosus*); LR2 0.43−0.56; LR3 0.47−0.60. Sensilla chaetica present or absent between and within species. Sensilla chaetica present on basal half of ta1 in p2 and sometimes in p3.

Hypopygium (Fig. 1). Virga present or absent between species and within species. Anal point medium to long, weak to robust, armed laterally with setae, and usually with a rounded tip, pointed tip only in some *abiskoensis* and *coffmani*. Superior volsella collarlike except in *abiskoensis*, triangular. Inferior volsella well developed with dorsal part squared, rounded, nose-like, either covering most of ventral part, or with ventral part extended weakly or prominently below. Gonostylus haired, robust, with grooved spine between two strong setae. Crista dorsalis long, absent only in *abiskoensis*. HR close to 2.00 or higher, except in some specimens of *rivicola* and *thienemanni*.

Variation. The tip of the anal point will apear more rounded if it is flattened down under the coverslip. Microtrichia appear on the anal point in specimens from the high arctic (e. g. *telochaetus*, *thienemanni*).

The crista dorsalis can appear strongly to weakly developed, depending on the orientation of the gonostylus. The effect of orientation on the gonostylus has been illustrated by, e.g. Oliver (1976, figs. 10−12) for *Oliveria tricornis* (Oliver).

The spine on the gonostylus is grooved and appears bifid. This may not be noticed unless the gonostylus is extended, exposing the spine. Usually the spine appears to be blunt at high magnification because of light shining between the bifurcation. This condition is not as pronounced as in some other chironomids, e.g., *Zalutschia briani* Soponis (1979).

The apodemes of the hypopygia are thickened in some species but this character is too variable within *Euorthocladius* to be of diagnostic value, as Schlee (1968) found for the *Corynoneura* group. Schlein and Gratz (1972) used daily growth in the skeletal apodemes of mosquitoes and in genitalic apodemes of muscoid flies in their studies, suggesting that the genitalic apodemes of chironomids may also be subject to variations produced by daily growth.

The virga is not a good diagnostic character in the subgenus *Euorthocladius*. Most members of the *rivicola*-group appear to have a virga present, but in some species of this group it may be present or absent. Whether the virga was never present or subsequently lost (e.g. after mating) is unknown.

The length of the palps is positively correlated with the interocular distance in *rivicola*, but not in *roussellae*, the only two species examined for this relationship.

The degree of the development of the antepronotal lobes corresponds to the orientation of the specimen, and is not a useful species character.

Oliver (1970) was the first to point out that acrostichals could be present or absent within *O. (Euorthocladius)*.

Pupa (Exuviae)

Light to dark brown; darker shading on cephalothorax; apophyses on tergites. Length 2.5–6.5 mm, variation in all species. Largest individuals belong to *roussellae, luteipes, thienemanni,* and *coffmani*; smallest individuals belong to *rivicola, rivulorum,* and *saxosus*.

Cephalothorax. Frontal setae absent. Frontal warts weak or absent, except in *saxosus*, robust; cephalic tubercles usually absent, but may be weakly developed in some species; 3 precorneals, usually clumped; 1–2 median antepronotals, 0–1 lateral antepronotals, 3 dorsocentrals in *rivicola*-group, 4 dorsocentrals in *rivulorum*-group and *abiskoensis* and *saxosus*. Development of cephalothoracic setae variable, from weak to well developed, except in *ashei*, thick and robust. Thoracic horn absent in *abiskoensis*; short (30–110 μm), ellipsoid, and stalked in *rivicola*-group and *saxosus*; long (170–440 μm), tubular, and bubbled or smooth in *rivulorum*-group. Cephalothorax can be dorsally smooth, wrinkled, granular, or rugose, and is variable and inconsistent within species except in *roussellae* and rugose.

Abdomen. Tergites with spine arrangements of 2 kinds: rows of straight spines on III–IV to VIII (*rivicola*-group); or hooklets on II or II–V (*rivulorum*-group). Some species (*abiskoensis, rivulorum, roussellae*) with shagreen of the *Orthocladius* (*Orthocladius*) type. In all species except *roussellae*, segment I bare of spines. Sternites with spinules on II–VII in different patterns. Dorsal o-setae in *coffmani, luteipes, rivulorum, roussellae*, and *saxosus*; absent in *abiskoensis, ashei, calvus, rivicola*, and *thienemanni*. Anal macrosetae absent. Anal lobe reduced laterally in *rivicola*-group and *saxosus*; strongly developed as large, circular lobes in *coffmani, suspensus*, and *rivulorum*-group; extended distally as long lobes in *abiskoensis* and *roussellae*. Spines on lobes of *roussellae*. Seta on distal half of lobe in *ashei, abiskoensis, coffmani, kanii, rivicola,* and *roussellae*; at midpoint in *abiskoensis, kanii, rivicola, roussellae*, and *thienemanni*; absent in *calvus, luteipes, rivulorum*, and *saxosus*. Lobe bare ventrally, covered with spinules dorsally, usually in a small anterior patch. Genital sheaths of males extended beyond tips of anal lobe in all species; extended beyond tips in females of *luteipes, rivicola, saxosus*, and *thienemanni*. Pedes spurii B absent in *abiskoensis*, and *rivicola*-group; present in *saxosus* and *rivulorum*-group. Pedes spurii A present in *calvus, luteipes, roussellae*, and *saxosus*.

Variation. The hooklets and spines in the spine rows on tergites II–VIII may be directed anteriorly or posteriorly. The direction of these moveable spines has no value as a taxonomic character. Hooklets and spines are probably moved as the pupa leaves its site upon eclosion. Hooklets, or recurved spines, are similar to those in *Orthocladius (Orthocladius)*. In the *rivicola*-group, *calvus* has a patch of spines on tergite II; these are not recurved, but straight and thorn-like (Fig. 37a).

The thoracic horn is stalked in the *rivicola*-group. The horn of *saxosus* is similar to that of *luteipes*, with a weakly developed stalk and a more easily collapsed horn. The thoracic horns of *rivicola, thienemanni*, and *ashei* are similar, with a more prominent stalk and a less easily collapsed horn.

Five dorsocentrals occur in some specimens of *rivulorum*, and no dorsocentrals can be found in some specimens of *saxosus*. The arrangement of dorsocentrals is inconsistent within species (see *rivulorum, roussellae, saxosus*). Dorsocentrals can be branched or forked (*ashei, rivicola*).

Larva (Fourth Instar)

Live larvae with body yellow, brown, or green, or variations of these, as in *saxosus* (yellowish-brown, reddish-brown, or greenish-brown). Head capsule light brown, except in *saxosus, kanii*, and

rousselae, dark brown; occipital margin and mouthparts darker. Eyespots both fused and bipartite, except in *rivicola, saxosus,* and *thienemanni,* fused. Mentum convex, with 13 teeth, except in *roussellae,* 15 teeth, and in *rivulorum,* 17–21 teeth. Mandible with 3 inner teeth, 4th tooth either separate or fused; length of apical tooth not longer than combined lengths of next 3 inner teeth except for *rivulorum;* seta interna absent only in *roussellae* when present with 6 branches, apices pointed; outer margin of mandible notched opposite seta subdentalis, rest of margin smooth or crenulate. Epipharynx with 3-toothed pecten; 4 chaetulae laterales, except in *rivulorum*, 9 (Thienemann's "moustache"); 2 chaetulae basales; spinules variable; ungula U-shaped; premandible usually simple, although often notched, except in *calvus, roussellae* and one specimen of *saxosus*, bifid; premandible irregularly shaped, blunt, wide, and with a noticeable, rounded inner lobe, except in *rivulorum*, pointed and without a lobe; SI bifid; SII robust, long, simple; SIII slender, long, simple; SIV peg-like, with base; SV peg-like, without base. Antenna 5-segmented; AR 1.38–3.08; Lauterborn organs robust, except in *rivulorum* and *roussellae*, weak to moderately developed; blade usually extended to 4th or 5th segment, except in some *saxosus*, extended beyond the tip. Procercus with 6 terminal and 2 lateral setae. Anal tubules long, rounded, and subequal in *abiskoensis, rivulorum, roussellae*, and *thienemanni*; dorsal pair shorter and thicker than ventral pair in *luteipes, rivicola*, and *saxosus.*

Variation. The color of the head capsule deteriorates after long storage in alcohol; brown head capsules may appear light yellow. Younger instars may have lighter head capsules, especially after molting. The shade or intensity of the head capsule is also geographically variable. Larval skins of *ashei* and *rivicola* reared from Norway have much darker head capsules than larval skins of *ashei* reared from Ireland and larval skins of *rivicola* reared from Canada.

The length of the apical tooth of the mandible depends on the orientation of the specimen. The apical tooth can appear greatly or slightly reduced in the same species, and there appears to be no trend within or between species.

Whether the 4th tooth of the mandible appears to be true (separate) or false (fused) is a character that is both consistent and variable, depending on the species. In *ashei, rivicola*, and *thienemanni*, the 4th tooth is fused to the mandible (false). In *abiskoensis* and *rivulorum*, the 4th tooth is separated from the mandible by a groove or space (true). Both conditions occur in *saxosus*. In the type mateial and in reared material from Montana, the tooth is fused; in reared material from Alberta, the tooth is separate. In specimens of *roussellae* collected in the same sample from Wyoming, some specimens have the 4th tooth fused, others separate. Chernovskii (1949) originally used this character in his key to orthoclad larvae, and Pankratova (1970) and Soponis (1977) used this character in *Orthocladius*.

The large and oddly-shaped premandible was rarely orientated in a favorable position to draw. It was difficult to determine whether or not the premandible was notched.

Setae on the larval body appear in different patterns (Fig. 57) and these may be taxonomically useful. Many of the larvae examined, however, had either no setae or only a few short, simple setae. Setae can be lost when larvae are not handled carefully during collection and preservation. Mounting media also affect the retention of setae differently, e.g. setae are retained better in Hoyer's than in either Euparalor balsam. Setae are commonly lost from the procercus. In *rivulorum*, 3 to 6 setae per procercus were observed.

The keys

To use the following keys effectively, good slides are essential. The Palearctic *Orthocladius (Orthocladius)* need to be revised, and there may be difficulties keying these species to subgenus. See Soponis (1977) for labelled structures.

Key to Adult males of *Orthocladius*

1. Hypopygium without well developed dorsal part of inferior volsella (Fig. 2) . . . . *Orthocladius (Eudactylocladius)*

   Hypopygium with well developed dorsal part of inferior volsella (Figs. 1, 3, 4) 2

2. Eyes extended dorsomedially, male-like (Fig. 12) ....
.... *Orthocladius (Orthocladius)* (part) (Soponis 1977)

Eyes widely separated, female-like (Fig. 13) 3

3. Anal lobe of wing strongly produced; fore tarsal beard present; scutellar setae uniserial or biserial; hypopygium as in Fig. 3 . . . *Orthocladius (Pogonocladius) consobrinus* (Holmgren)

With another combination of characters 4

4. Scutellar setae uniserial 5

Scutellar setae biserial or multiserial 7

5. Gonostylus with robust crista dorsalis (Figs. 32, 33) ....
.... *Orthocladius (Euorthocladius) rivicola* Kieffer (part)

Gonostylus with weak or no crista dorsalis (Figs. 7, 8) 6

6. Virga present or superior volsella collar-like ....
.... *Orthocladius (Orthocladius)* (part) (Soponis 1977)

Virga absent and superior volsella triangular (Figs. 7, 8) ....
.... *Orthocladius (Euorthocladius) abiskoensis* Thienemann & Krüger (part)

7. Antennae reduced and gonostylus with large projection on dorsal edge proximally (Fig. 5) . .
.... *Orthocladius (Orthocladius) ferringtoni* Soponis

Antennae not reduced and gonostylus without large projection on dorsal edge 8

8. Superior volsella collarlike (Fig. 1) 9

Superior volsella not collarlike .... *Orthocladius (Orthocladius)* (part)

9. Dorsocentral setae biserial to multiserial *Orthocladius (Orthocladius) smolandicus* Brundin

Dorsocentral setae uniserial 10

10. Gonostylus with weak or no crista dorsalis (Figs. 7, 8) ....
.... *Orthocladius (Orthocladius) abiskoensis* Thienemann & Krüger (part)

Gonostylus with robust crista dorsalis 11

11. Gonostylus complex; hypopygium (Fig. 4) ....
.... *Orthocladius (Orthocladius) trigonolabis* Edwards

Gonostylus simple; hypopygium otherwise 12

12. Inferior volsella appearing doubled, dorsal part subequal to ventral part as in some *Orthocladius (Orthocladius)* (Figs. 9, 10) 13

Inferior volsella not appearing doubled, dorsal part not subequal to ventral part 14

13. Palpal segment 3>4; anal point weak (Fig. 9) .... *coffmani* n. sp.

Palpal segment 3<4; anal point robust (Fig. 10) .... *anteilis* (Roback)

14. Lateral antepronotals >8; hypopygium as in Figs. 11, 14, 15 .... *roussellae* n. sp.

Lateral antepronotals <8; hypopygium not as above 15

15. Inferior volsella with ventral part extended ventrally and laterally to dorsal part (Figs. 16, 18) 16

Inferior volsella with ventral part not extended, or only extended ventrally below dorsal part 17

16. Anal point with apical seta (Fig. 16); squamals >23 .... *telochaetus* Langton

Anal point without apical seta (Figs. 18, 19); squamals <23 .... *saxosus* (Tokunaga)

17. Inferior volsella with dorsal part arched convexly (Figs. 20, 21) .... *rivulorum* (Kieffer)
Inferior volsella with dorsal part not arched convexly .... *rivicola*-group 18

18. AR > 1.75 19
AR < 1.75 22

19. Inferior volsella with dorsal part wide, squared (Figs. 22, 23) 20
Inferior volsella with dorsal part narrow, long (Figs. 25, 28) 21

20. Europe, North America; hypopygium as in Fig. 23 .... *luteipes* Goetghebuer (part)
Japan; hypopygium as in Fig. 22 .... *kanii* (Tokunaga) (part)

21. Palpal segment $3>4$; hypopygium as in Figs. 25, 26 .... *calvus* Pinder
Palpal segment $3<4$; hypopygium as in Figs. 27, 28 .... *thienemanni* Kieffer

22. Inferior volsella with most of ventral part covered by dorsal part (Figs. 17, 22, 23) 23
Inferior volsella with most of ventral part extended below dorsal part (Figs. 29–33) 25

23. Palpal segment $3<4$; hypopygium as in Fig. 17 .... *suspensus* (Tokunaga)
Palpal segment $3>4$; hypopygium as in Figs. 22, 23 24

24. Europe, North America; hypopygium as in Fig. 23 .... *luteipes* Goetghebuer (part)
Japan; hypopygium as in Fig. 22 .... *kanii* (Tokunaga) (part)

25. Inferior volsella with ventral part extended prominently below dorsal part (Fig. 31); Greenland .... *difficilis* (Lundbeck)
Inferior volsella with ventral part less prominently extended below dorsal part 26

26. Sensilla chaetica absent on ta 1 of p 2; hypopygium as in Figs. 29, 20 .... *ashei* n. sp.
Sensilla chaetica present on ta 1 of p 2; hypopygium as in Figs. 32, 33 . . *rivicola* Kieffer (part)

Key to Pupae (Exuviae) of *Orthocladius*

1. Anal lobe with 3 anal macrosetae .... *Orthocladius (Orthocladius)*
.... *Orthocladius (Pogonocladius)*
.... *Orthocladius (Eudactylocladius)*
Anal lobe without anal macrosetae .... *Orthocladius (Euorthocladius)* 2

2. Tergite II with median patch of hooklets along posterior margin (Figs. 38 a, 39) ....
.... *rivulorum*-group 3
Tergite II usually bare (Figs. 48, 49); if with median patch along posterior margin, then patch with straight spines and not hooklets (Fig. 37 a) .... *rivicola*-group 8

3. Tergite III with central round patches of strong spines anteriorly (Figs. 38 a, 39 4
Tergite III without central round patches of strong spines anteriorly 6

4. Tergite III with large (>200 μm wide) round patch of spines anteriorly that reaches midline of tergite (Fig. 39) .... *coffmani* n. sp.
Tergite III with small (<150 μm wide) round patch of spines anteriorly that does not reach midline of tergite (Fig. 38 a) 5

5. Thoracic horn bubbled (Fig. 34 b); tergites IV–VI with rows of spines along posterior margin .... *rivulorum* Kieffer

Thoracic horn smooth; tergites IV–VI without rows of spines along posterior margins . . . . *suspensus* (Tokunaga)*

6. Anal lobe with spines on tips (Fig. 41) . . . . *roussellae* n. sp.
   Anal lobe without spines on tips 7

7. Frontal warts robust (Fig. 43); thoracic horn present (Fig. 34 e); hooklets on tergite II with >100 spines; hooklets in a large patch of 3–5 rows (Fig. 44) . . . . *saxosus* (Tokunaga)
   Frontal warts weak or absent; thoracic horn absent; hooklets on tergite II with <50 spines; hooklets in a small patch of 1–2 rows (Fig. 45) . . . . *abiskoensis* Thienemann & Krüger

8. Tergite II with median patch of strong thorn-like spines along posterior margin (Fig. 37 a) . . . . *calvus* Pinder
   Tergite II bare 9

9. Pedes spurii A present on sternite VI; spines individually slender (Fig. 37 b) in rows on posterior margins of tergites (Figs. 46, 47) . . . . *luteipes* Goetghebuer
   Pedes spurii A absent on sternite VI; spines individually robust (Figs. 37 c, d, e) in rows on posterior margins of tergites 10

10. Tergite III with rows of spines on posterior margin (Fig. 42) . . . . *thienemanni* Kieffer
    Tergite III without rows of spines on posterior margin 11

11. Dorsocentrals thick, robust (Fig. 36); spines in spine rows on posterior margins of tergites IV–VIII individually robust (Fig. 37 e); spines on VI <40 (Fig. 48) . . . . *ashei* n. sp.
    Dorsocentrals normally developed (Fig. 35); spines in spine rows on posterior margins of tergites IV–VIII individually normally developed (Fig. 37 c); spines on VI >40 12

12. Europe, North America; abdomen as in Fig. 49 . . . . *rivicola* Kieffer
    Japan . . . . *kanii* (Tokunaga)*

Key to Larvae (Fourth instar) of *Orthocladius*

1. Mentum with 2 teeth . . . . *Orthocladius (Orthocladius) lignicola* Kieffer
   Mentum with 13 or more teeth 2

2. Mentum with >13 teeth . . . . *Orthocladius (Euorthocladius)* (part) 3
   Mentum with 13 teeth 5

3. Mentum with 15 teeth (Fig. 50 e) mandible without seta interna (Fig. 50 c) . . . *roussellae* n. sp.
   Mentum with >15 teeth (Fig. 51 e); mandible with seta interna 4

4. Europe, North America; Fig. 51 . . . . *rivulorum* Kieffer
   Japan . . . . *suspensus* (Tokunaga)*

5. Head capsule yellow . . . . *Orthocladius (Orthocladius)*
   Head capsule brown 6

6. Antenna 4-segmented; Lauterborn organs weak . . . . *Orthocladius (Pogonocladius) consobrinus* (Holmgren)
   Antenna 5-segmented; Lauterborn organs robust 7

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* based on literature; specimens not seen

7. Head capsule dark reddish brown .... *Orthocladius (Eudactylocladius)*
   Head capsule light to dark brown, not reddish .... *Orthocladius (Euorthocladius)* part ... 8
8. Mentum with median tooth >1.5X width of 1st lateral (MR > 1.5) 9
   Mentum with median tooth <1.5X width of 1st lateral (MR <1.5) 12
9. AR >1.85 10
   AR <1.85 11
10. Premandible bifid .... *calvus* Pinder
    Premandible simple .... *thienemanni* Kieffer
11. Europe, North America; head capsule brown .... *luteipes* Goetghebuer
    Japan; head capsule dark brown .... *kanii* (Tokunaga)*
12 AR lower (<1.80) .... *ashei* n. sp., *rivicola* Kieffer
   AR higher (>1.80) 13
13. Head capsule dark brown .... *saxosus* (Tokunaga)
    Head capsule light brown or brown .... *abiskoensis* Thienemann & Krüger

Orthocladius (Euorthocladius) abiskoensis Thienemann & Krüger

Figs. 6–8, 45, 60

"*Orthocladius*" *abiskoensis* Thienemann & Krüger, 1937: 257–265, 267, figs. 1 a, 3 a, 4 a, 5, 6 a, 8 a, 9 a [pupal, larval description].

Lapporthocladius abiskoensis (Thienemann & Krüger), 1937: 266.

Orthocladius (s. str.) *abiskoensis* Edwards, 1937: 144–145 [adult description].

Lapporthocladius abiskoensis (Edwards). Zavřel, 1938: 8, 9 [comparative analysis of larvae]. Thienemann, 1941: 66, 68, 82, 150, 180 [ecology, distribution]. Thienemann, 1944: 564, 647, figs. 20, 21, 197 a, 198 a [in pupal, larval keys]. Thienemann, 1954: 182, 188, 355, 357 [notes]. Brundin, 1956: 103 [systematic placement]. Fittkau et al., 1967: 358 [checklist]. Fittkau & Reiss, 1978: 418 [checklist].

Orthocladius (O.) abiskoensis Edwards. Goetghebuer, 1942: 35, 37 [in male key, adult description].

"*Orthocladius*" *abiskoensis* Edwards. Saether, 1969: 65 [note].

Orthocladius (Lapporthocladius) abiskoensis Edwards. Pankratova, 1970: 173, 174, 182, 183, fig. 110 [pupal, larval description, in pupal, larval keys].

Orthocladius (Euorthocladius) abiskoensis Edw. Säwedal, 1978: 85, 86 [ecology].

Orthocladius (Euorthocladius) Type III Soponis, 1977: 15–17, fig. 122 [pupal, larval diagnosis, in pupal, larval keys].

[non] *Orthocladius (Euorthocladius)* Type III sp., Simpson & Bode, 1980: 52 [misidentification of *luteipes* and *rivicola*].

Type Locality: Sweden, Lappland nr. Abisko.

Type Material: Lectotype: Male pupa, Lappland, Sweden, 10 VI 1936, A. Thienemann, labelled by Thienemann as *Orthocladius abiskoensis* Edw. Lappland 1936 3d (ZSM). On a slide with paralectotypes, lectotype indicated in ink as in Fig. 7. Paralectotypes (23): same data as lectotype, 8Ex (7M, 1F), 1 larval head capsule, 3MP, 1FP, 1MP abdomen. Same data as lectotype except 3c, 4FP, 5L. The specimens are mounted in balsam on a total of 6 slides and kept at the ZSM. According to notes of Thienemann (pers. comm. F. Reiss), 3d indicates that diverse chironomid larvae were reared, but only 2 specimens hatched and the others died (as pupae); 3c indicates that isolated larvae of *abiskoensis* were reared. The specimens described above are hereby designated lectotype and paralectotype.

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* based on literature; specimens not seen

Diagnosis

Orthocladius abiskoensis can be distinguished from other Holarctic species of O. *(Euorthocladius)* by a combination of characters. Adult Male: details of the hypopygium (Figs. 6–8). Pupa: thoracic horn absent, frontal warts weak or absent, tergites II–V with hooklets on posterior margins, hooklets in small patches of 1–2 rows; tergite III without central round patches of strong spines anteriorly. Larva: mentum with 13 teeth, MR<1.5, AR>1.80, head capsule brown.

Derivation of Name: Abisko; L. *ensis*, denoting place, locality.

Description

Adult Male (n=17)

Brown. Small to medium species. Head. Verticals 9–14, postorbitals 1–3. Palps long with 3≥4. AR 1.22–1.71. Thorax. Lateral antepronotals 2–6. Acrostichals 1–13, robust, begin within 2AW. Dorsocentrals 4–12. Prealars 4–7. Scutellars 7–14, usually uniserial, less often biserial (20%). Wing. Length 1.38–2.32 mm. R with 2–10 setae. Squamals 14–33. In one specimen 2 setae on R4+5. VR 1.03–1.12. Anal lobe moderately produced. Legs. LR1 0.57–0.67. LR2 0.44–0.53. LR3 0.48–0.59. Sensilla chaetica on ta1 of p2, 6–22 (15), and p3, 0–8 (15). Hypopygium (Figs. 6–8). Virga absent. Superior volsella triangular with pointed or blunt apices. Inferior volsella with dorsal part nose-like, covering most of ventral part. Crista dorsalis weak.

Variation. The material examined contains variants in 2 or 3 populations. Males of high arctic populations from Isachsen, Northwest Territories, are large specimens, with a robust anal point, squared inferior volsella, and full superior volsella (Fig. 8a). Males from more temperate populations of Caribou Bar Creek, Yukon Territories, (Fig. 8c) more closely resemble Edward's original material (Fig. 6) from Abisko in the superior volsella and slender anal point. At least one specimen from Abisko has a robust anal point. The immature stages of rearings from three Canadian sites (Hazen Camp, Banks Island, Caribou Bar Creek) agree with each other in diagnostic features. The scutellars can be either uniserial or biserial. The number of sensilla chaetica varies in this species. The crista dorsalis is not evident in all specimens.

Edwards (1937) separated *abiskoensis* by the relative lengths of palpal segments 5 to 4, a ratio of 1.5. Here (n=14), the ratio varies from 1.2 to 1.7. The color of the thorax or the patterns of the scutal stripes in *abiskoensis*, characters used by Edwards, were not analysed here because these characters cannot be accurately assessed in slide-mounted material. The shading of the scutellum is also unreliable in slide-mounted specimens, since it is essentially the same in all the material.

Pupa (Exuviae)

Light brown, with dark apophyses on II–VII (variable); length about 3.0–4.25 mm (10). Cephalothorax. Frontal warts weak and cephalic tubercles absent. Precorneals clumped; 2 median antepronotals, 1 lateral antepronotal, moderately developed; 4 dorsocentrals, slightly shorter than precorneals but thicker; arrangement varies. Thoracic horn absent. Thorax dorsally slightly wrinkled along eclosion line.

Abdomen (Fig. 45). Tergites: I bare; II–V with small central patch of recurved hooklets in 1–2 rows along posterior margin; III–VIII with large central patch of spinules separated from posterior spine patch. Sternites: I bare; II–VII with spinules anteriorly in varying amounts; VIII with 2 off-center patches of spinules anteriorly.

Setae on segments I–VIII:

D	4	5	5	5	5	5	5	2
V	1	4	4	4	4	4	4	1
L	1	3	3	3	3	3	4	4
Od	0	0	0	0	0	0	0	0

Anal lobe developed as slender processes with tendency for tips to curve inwards; 2 robust or fine setae, one on proximal half and one at midpoint; genital sheaths extended beyond lobe in male, not in female. Pedes spurii A, pedes spurii B absent.

Variation. Spine patterns are variable: the sternites may appear bare, and anterior spine patches on the tergites may be less developed than described here.

Larva (Fourth Instar)

Body yellow or brown. Head capsule brown. Eyespots bipartite or fused. Head capsule (Fig. 60c) widest midway between eyespots and postoccipital margin. Mentum (Fig. 60b) convex with 13 teeth, median tooth about as wide as 1st lateral; MR 1.0–1.3 (3); median tooth as high as 1st lateral. Ventromental plates extended anteriorly between 2nd and 3rd laterals. Epipharynx (Fig. 60a) with premandible simple, narrowed before enlarged apex; apex is notched in Thienemann material. Chaetula laterales sparse. Mandible (Fig. 60g) with apical tooth as long or longer than 1st inner tooth; outer margin notched opposite seta subdentalis, rest of margin smooth except for occasional notch posteriorly; seta interna present. Antenna (Fig. 60h) with robust Lauterborn organs; blade extended to 4th segment. AR 2.00–2.50 (3). Body bare except in one specimen, haired. Anal tubules (Fig. 60f) subequal.

Variation. Pankratova (1970) described the body as bare, greenish-brown, and the head capsule as dark brown. She described the premandible with 3 blunt teeth. In material examined here, the premandible appears simple.

Biology. Larvae and pupae were collected near Abisko in the moss of a spring. Pupae in gelatinous, half-ellipsoid cases were also collected on bare stones, without vegetation. The species occurs in cold rivers, streams, and springs. Males swarm beside *Micropsectra* (?) *brunippes* Zett. (Thienemann & Krüger, 1937, Thienemann 1941, 1954). *Orthocladius abiskoensis* was previously recorded only from high latitudes, but exuviae have also been collected in Kansas. Adults emerge in June and July in the arctic, and in March in Kansas.

Distribution. Palearctic: Sweden. Nearctic: Canada, USA.

Material Examined. Type material. Non-type Material: Canada (CNC). Northwest Territories: Isachsen, 14-VII-1960, J. F. Mc Alpine, CH1075, 10M, 3F; Hazen Camp, 81° 49'N 71° 18'W, 13-VII-1961, D. R. Oliver, CH1133, 1M w/Ex; same data except 27-VII-1961, Ch1047, 2MP, 2Ex; Banks Is., Masik R., 4-VI-1968, W. R. M. Mason, CH2063, M, F in copula; Harris River, 61° 52'N 121° 19'W, 18-V-1973, FWI Pipeline Proj., CH803.12, 1M w/Ex: CH803.23, 1MP; Bathurst Is., 75° 24'N, 100° 24'W, 25-VII-84, B. Hayes, 1M w/Ex, Yukon Territory: Caribou Bar Creek, 67° 28'N 140° 37'W, 11-VI-1973, D. R. Oliver, CH874, 3M, 1P, 7Ex; same data except 20-VI-1972, CH126, 1M; 19-VI-1972, CH128, 1M; 15-VI-1973, CH562.1, M w/Ex, LS; 18-VI-1973, J. Robillard, CH564.6, M w/Ex, LS, CH564.10, MP w/LS, 29-VI-1972, FWI Pipeline Proj., CH6205, 1L. Sweden: Lappland, 1936, 3d, Thienemann, 5P, 8Ex, 1LS; Lappland, 1938, No. 125, Thienemann, 7L (ZSM). USA. Kansas: Leavenworth Co., Plum Creek, 1.2 mi S, 0.2 mi E of Kickapoo, 24-III-1982, L. Ferrington, 2Ex (KSBS).

Remarks. This species was collected by Thienemann as adult and immature stages in the summer of 1936 at a spring among dwarf birches, near the road Abisko-Björkliden in Swedish Lappland (Thienemann & Krüger 1937, Edwards 1937, Säwedal 1978). Thienemann sent the adult males to Edwards, who initially determined them as „*Orthocladius* ? *rubicundus* Mg. var. or *decoratus* Holmgren?“ (Thienemann & Krüger 1937). Thienemann questioned the determination of the adult because of the associated immature stages. The pupa of *rubicundus* belonged to Thienemann's *Rheorthocladius* (=*Orthocladius* s. str.), and Thienemann thought that the unusual pupa of *abiskoensis* belonged to a new species.

To provide Thienemann with a name for the new species, Edwards (1937) published a brief adult description, primarily distinguishing *abiskoensis* from *rubicundus* and *decoratus* by the shading of color on the thorax. He also used the lengths of palpal segments 3 and 4 (here 4 and 5) to distinguish *abiskoensis* from *rubicundus*, adding that the character is individually variable. Edwards regarded *abiskoensis* as a pupal species: "the pupae are so strikingly different, but the adults scarcely if at all distinguishable."

The same year Thienemann & Krüger (1937) provided a detailed description including figures of the pupa and larva of *abiskoensis*, comparing it with the immature stages of *rubicundus*. They cited Edwards's pending adult description, but their own paper was published first. Thienemann & Krüger (1937) was published 15 March 1937 and received in the BM(NH) 8 April 1937. Edwards (1937) was published July 1937 and received in the BM(NH) 16 July 1937 (pers. comm. P. S. Cranston). According to Article 50 of the rules of the International Code of Zoolo-

gical Nomenclature, i.e. the author of a name is the person who first validly publishes it, the authors of *abiskoensis* are Thienemann & Krüger.

Thienemann & Krüger (1937) used "*Orthocladius*" *abiskoensis* in the title and referred to the binomen *O. abiskoensis* once again in the paper. However, inthe last paragraph of the summary, they erected the genus *Lapporthocladius* to accommodate *abiskoensis*. Because the authors referred twice to *abiskoensis* as *Orthocladius*, and because the original specimens are labelled in Thienemann's handwriting as *Orthocladius abiskoensis*, this is interpreted to mean that the authors described *abiskoensis* in *Orthocladius*, and then erected *Lapporthocladius* for the species. Thienemann (1941, 1944, 1954) and others (Fittkau et al. 1967, Fittkau & Reiss 1978) placed *abiskoensis* in the monotypic genus *Lapporthocladius*. Säwedal (1978) synonymyzed *Lapporthocladius* with *Orthocladius*.

Hamilton et al. (1969) recommended that a genus should have all three life stages in a relatively discernible group. Because the male of *abiskoensis* is not distinguishable from other adult *Orthocladius* at the generic level, *abiskoensis* is not placed in another genus, i.e. *Lapporthocladius*. Also, *abiskoensis* is not placed in its own subgenus because the immature stages belong to *O. (Euorthocladius)* as defined here.

Zavřel (1938) considered the generic placement of *abiskoensis* in a description of the immature stages of *Orthocladius frigidus*. He concluded that the larva of *abiskoensis* is closer to the larvae of Thienemann's *Euorthocladius* (excepting *rivulorum*) than to the larva of *frigidus*, and that on the whole, *abiskoensis* belongs to *Euorthocladius*.

Pankratova (1970) redescribed the pupa and larva of *abiskoensis*, reproducing the figures of Thienemann & Krüger (1937). She placed *abiskoensis* in the genus *Orthocladius*, subgenus *Lapporthocladius*, and stated that the species would probably occur in the USSR.

Goetghebuer (1942), treating adults, followed Edwards (1937) and separated *abiskoensis* from *rubicundus* primarily on AR, thoracic color, and palpal proportions. He provided no figures.

Brundin (1956) reviewed the systematic position of *abiskoensis* as an example of incongruity of adult and immature chironomids. He examined two males (one a pupa) of Edwards's original material, specimens in poor condition due to long storage in alcohol. Brundin observed strewn scutellar setae that would place the adult in his subgenus *O. (Euorthocladius)*. However, he concluded that the position of *abiskoensis* was still unstable. Saether (1969) referred to the incongruity, and both Soponis (1977), as Type III, and Säwedal (1978) placed *abiskoensis* in *O. (Euorthocladius)*.

Until now, no figure of the hypopygium of *abiskoensis* has been available. It was impossible to identify the adult of this species without the associated pupal skin. The species is still difficult to identify in the adult male, but this situation occurs in other *Orthocladius*, not just *abiskoensis*.

Orthocladius (Euorthocladius) anteilis (Roback)

Fig. 10

Hydrobaenus anteilis Roback, 1957b: 14, figs. 41–45 [description of female]. Roback, 1959: 2–3, figs. 7–10 [description of male and female]. Cole, 1969: 101 [notes].

Orthocladius anteilis (Roback). Sublette & Sublette, 1965: 155 [checklist].

Type Locality: USA: Utah, Provo River.

Type Material: Holotype. Female, remounted by M. E. Roussel Dillon, in Canada balsam under 5 coverslips, genitalia in lateral view. Original white label: 8. ant. wing Hydrobaenus anteilis Roback 6803 det. S. S. Roback. Red label: Utah, Summit Co., South Fork of Provo River on Stewart's Ranch, 20 Feb. 1954, Gerald D. Brooks (ANSP). Paratype. Female, same data, not seen, reportedly in University of Utah collection.

Diagnosis: The male of *Orthocladius anteilis* can be distinguished from other males of *O. (Euorthocladius)* by palpal segment 3<4 and details of the hypopygium (Fig. 10). The pupa and larva are unknown.

Derivation of Name: ant; L. *ilis*, having the nature or quality of.

Description: See Roback (1957b, 1959).

Biology: Adults have been collected along rivers in western USA.

Distribution: Nearctic: USA.

Material Examined: Type Material. Non-type Material: Idaho: Freemont-Teton Co. border, north Fork of Teton R., Hwy. 32, 6-III-1965, A. v. Nebeker (MINN), 1 M. Photographs of males and females of Montana specimens of Roback (1959), supplied by J. E. Sublette.

Remarks: Roback (1957b) described this species from two females collected along the Provo River in Utah. Later Roback (1959) described the male and gave a further description of the female based on five males and two females collected along the Blackfoot and Clard Fork Rivers in Montana.

The holotype is an adult female, but the female of *anteilis* has never been associated through rearing or by copulation with the male. The males and females from Montana, also unassociated, do not convincingly belong to *anteilis*. Other species of O. *(Euorthocladius)*, e.g. *saxosus* and *coffmani*, occur in mountain rivers of the western USA so that locality and habitat cannot determine species in this subgenus. Although the study of females has advanced (e.g. Saether 1977) since Roback's description, it is still not possible to distinguish females of O. *(Euorthocladius)* to species.

To define the limits of *anteilis*, it is necessary to study reared females and reared males. Until such specimens become available, the males described by Roback (1959) are tentatively recognized as *anteilis*.

Orthocladius (Euorthocladius) ashei n.sp.

Figs. 29, 30, 36, 37e, 48, 54

Orthocladius rivicola Kieffer. Thienemann, 1911: 637 [pupa].
Orthocladius (Euorthocladius) cf. *thienemanni* (Kieffer). Halvorsen et al., 1982: 119 [record in Norway].
Orthocladius (Euorthocladius) rivicola β Rossaro, 1982: fig. 31 [pupa]. Langton, 1984: 142, fig. 49 [pupa].
Orthocladius (Euorthocladius) ? *rusticus* Goetghebuer. Murray & Ashe, 1983: 224, 225, 230 [checklist, pupa].

Type Locality: Ireland: River Flesk.

Type Material: Holotype. Reared male with larval skin and exuviae. Ireland, Kerry Co., Sta. 6, Clydagh Br., River Flesk, 16-V-1978, Drift D7, W114826, reared 16th–19th, P. Ashe, in gelatinous case. On slide, deposited in the National Museum of Ireland, Type No. NMI 106: 1984. Paratypes (83). Same data as holotype, 1 reared M w/LS, 1 reared M with LS, Ex Bulgaria, r. Bistriza, outfall, 14-IV-1971, N. Natchev, 1 Ex (NAT). Germany. River Isar, ca. 500 m oberhalb Loisach-Mündung, 3-IV-1986, F. Reiss, 5 Ex; Stauseen, Unterer Inn, drift, 6-IV-1978, Egla, F. Kohmann, 1 Ex; Westfalia, Urf-Talsperre, Sta. I, 4-IV-1910, A. Thienemann, 5 Ex; Westfalia, Glor, 7-VI-1908, A. Thienemann, 2 Ex; Westfalia, Fulbecke-Talsperre, 14-IX-1909, Oberfl., A. Thienemann, 1 Ex Ireland. Kerry Co., River Flesk, Sta. 1a, V964894, Ranunculus, 14–17-V-1978, P. Ashe, 1 reared F w/Ex (slide), 2 reared F w/Ex (alcohol); same data except 14–19-V-1978, 1 F w/Ex (alcohol); River Doddler, above Bohemabroinne Bridge, 3-IV-1978, P. Ashe, 1 F w/Ex, probable LS (alcohol). Italy. Po River, 1975, 1976, B. Rossaro, 12 Ex (slides), 40 Ex (alcohol). Norway. Ekse, HOi: Vaksdal, "The Weir Project," 11-VI-1979, E. Wilassen, 1 reared M w/Ex, LS (ZMB) (data in Halvorsen et al., 1982). Sweden. Lappland, Thienemann: River Abisko, 24-IV-1936, 48a, ex mosses, 2 Ex; Lake Abisko, 23-IV-1936, 40, ex moses, 3 Ex; Lke Kanevegge, 17-VII.1937, 98c, surface drift, 2 Ex; delta of River, 17-VII-1937; Abisko, 19-VII-1937, 101, surface drift, 1 Ex (ZSM). Paratypes will be deposited as follows: 2 reared F, Ireland, alcohol (NMI, No. NMI 106: 1984); 1 reared F, Ireland, alcohol (BMNH); 1 reared M, Ireland, slide, 1 reared F, Ireland, alcohol (DUB); 1 reared M, slide Ireland (FSCA); 1 reared M, Norway, slide (ZMB); 1 reared F, Ireland, slide, (ZSM); Ex, Bulgaria, slide, (NAT); Ex, Italy, alcohol, (ROSS); Ex, Italy, slides (CNC, BMNH, FSCA, COFF); Ex, Sweden and Germany (ZSM).

Diagnosis:

Orthocladius ashei can be distinguished from other Holarctic O. *(Euorthocladius)* by a combination of characters. Adult male: low AR (<1.80), absence of sensilla chaetica on ta1 of p2, and details of the hypopygium (Figs. 29, 30). Pupa: tergite II bare, robust dorsocentrals and robust spines on margins of tergites IV–VIII. Larva: mentum with 13 teeth, MR<1.5; cannot be distinguished from *rivicola*.

Derivation of Name: this species is named after Patrick Ashe, for his help in providing reared material and for his interest in this new species.

Description

Adult Male (n=4)

Dark brown to light yellow. Small species. Head. Verticals 12–13, postorbitals 1–2 (3). Palps normal with 3≥4. AR 1.18–1.62. Thorax. Lateral antepronotals 5–7 (3). Acrostichals 5–8, robust, beginning within 1–2 AW. Dorsocentrals 8–11. Prealars 5–7. Scutellars 7–15 (3), weakly biserial (Norway) to multiserial. Wing. Length 1.68–1.90 mm (3). R with 6–10 setae. Squamals 8–18. VR 1.03–1.22 (2). Anal lobe slightly produced. Legs. LR1 0.69–0.77 (3). LR2 0.48–0.56 (2). LR3 0.53–0.59 (3). Sensilla chaetica absent. Hypopygium (Figs. 29, 30). Virga present, moderately well developed. Superior volsella collar-like. Inferior volsella with dorsal part nose-like, or squared, and ventral part weakly extended below. Crista dorsalis long.

Pupa (Exuviae)

Light brown; length 3.1–3.4 mm (5).

Cephalothorax. Frontal warts absent; cephalic tubercles weak. Precorneals clumped, PC1, thick and almost 2x as long as PC2 and PC3; 1 median antepronotal, 1 lateral antepronotal, 3 dorsocentrals (Fig. 36), slightly longer than PC1 and thicker. Thoracic horn ellipsoid, light brown, clear, stalked, length 30–60 μm (5). Thorax dorsally wrinkled to granulose along eclosion line and anterior to wing base.

Abdomen (Fig. 48). Tergites: I–III bare; IV–VIII with rows of individually heavy spines along posterior margin (Fig. 37e); V–VIII with central patches of robust spinules anteriorly. Sternites: I, VIII bare; II, III with large central patch of spinules; IV–VII with anterior patch of spinules.

Setae on segments I–VIII (robust):

D	2	5	5	5	5	5	5	2	L	1	2	3	3	3	3	3	2
V	1	4	4	4	4	4	4	0	Od	0	0	0	0	0	0	0	0

Anal lobe greatly reduced; 2 setae on distal half. Pedes spurii B and pedes spurii A absent. Genital sheaths extended beyond lobe in male, not in female.

Variation. Dorsocentrals can be forked. The spines in the posterior rows on tergites IV–VIII are individually robust (Fig. 37e), much more robust than those in *rivicola* (Fig., 37c). The number of spines in these rows are higher in females than in males, and are not significantly different.

	ashei females (n = 5)		*ashei* males (n = 5)		Student's t
IV	30.60 ± 11.04	(20–45)	22.60 ± 8.20	(14–33)	1.3009
V	33.20 ± 8.87	(27–48)	25.60 ± 5.86	(20–34)	1.5988
VI	28.20 ± 8.32	(22–40)	22.20 ± 6.26	(18–33)	1.2887
VII	22.20 ± 7.22	(16–30)	18.60 ± 2.97	(14–22)	1.0307
VIII	16.00 ± 5.20	(12–25)	14.60 ± 3.36	(11–20)	0.5058

The number of spines in these rows can be used to distinguish most specimens of *ashei* from *rivicola*, and are significantly different.

	ashei (n = 10)		*rivicola* (n = 10)		Student's t
IV	26.60 ± 10.09	(14–45)	64.10 ± 25.30	(36–104)	4.3544
V	29.40 ± 8.14	(20–48)	69.30 ± 21.15	(47–100)	5.5676
VI	25.20 ± 7.63	(18–40)	62.10 ± 20.91	(41–103)	5.2428
VII	20.40 ± 5.54	(14–30)	50.70 ± 18.87	(33– 90)	4.8725
VIII	15.30 ± 4.19	(11–25)	35.40 ± 16.24	(20– 70)	*3.7893

(p >.001 except for *, p >.01)

Exuviae from Italy show variation in size, shade of color, and thickness and length of dorsocentrals. Generally *ashei* is lighter and more weakly chitinized than *rivicola,* and the cephalothorax of *ashei* is as light as the abdomen, whereas in *rivicola* the cephalothorax tends to be darker than the abdomen. Separation of exuviae of *ashei* from *rivicola* in alcohol is not foolproof, and slides should be made for positive determinations.

Larva (Fourth Instar)

Body green with blue tinge when live (Thienemann notebooks). Head capsule brown; preserved, yellow. Eyespots absent in reared specimens. Mentum (Fig. 54e) with 13 teeth, median tooth about as wide as 1st lateral; MR 1.3 (3); median tooth as high as 1st lateral. Ventromental plates extended anteriorly between 2nd and 3rd laterals. Premandible simple, with blunt or squared apex; apex may appear notched. Chaetula laterales sparse. Mandible (Fig. 54c) with apical tooth as long or longer than 1st inner; outer margin notched opposite seta subdentalis; rest of margin smooth except for occasional notch posteriorly; seta interna present. Antenna (Fig. 54d) with robust Lauterborn organs; blade extended to 4th segment. AR 1.80 (1). Body with simple setae, some short and stiff, some long and curved, apparently arranged like that of *saxosus.* Anal tubules not distinguishable.

Biology: The larvae live in gelatinous tubes in running water and are associated with plants. Ashe reared larvae from *Ranunculus,* and Thienemann collected exuviae from mosses in Lake Abisko and River Abisko. The species occurs with *rivicola* in Brehm, Italy, and River Isar, Germany (Ex). Adults emerge in April, May, and June.

Distribution: Palearctic: Bulgaria, France, Germany, Ireland, Italy, Norway, Sweden.

Remarks: This species was reared by Patrick Ashe from the River Flesk, Ireland. Originally Ashe (pers. comm.) suspected that this species might be *Orthocladius rusticus* Goetghebuer, based on a slide of an exuviae labelled *rusticus* in the Humphries collections (Murray & Ashe 1983). Professor Humphries reared larvae to adults, then sent the adults to Goetghebuer or Freeman for a positive determination to species. When the name was provided she labelled the associated immature material with the corresponding determination. The holotype male of *Orthocladius rusticus* Goetghebuer belongs to *Chaetocladius* (Soponis 1986) and is not conspecific with *Orthocladius ashei.*

Dr. Declan Murray (Murray & Ashe 1983) has seen material of *O. ashei* in the Humphries collection collected by Thienemann in "Norway", identified by Thienemann as *Euorthocladius thienemanni.* Murray has collected *ashei* in Norway and France.

Orthocladius ashei is morphologically similar in all stages to *rivicola:* the larvae of these two species could not be distingushed. These two species can most easily be distinguished as pupae.

Orthocladius (Euorthocladius) calvus Pinder

Figs. 25a, 26, 37a, 37f

Orthocladius (Euorthocladius) calvus Pinder, 1985: 235–241, figs. 1–3 [description of male, female, pupa, and larval].

Orthocladius (Euorthocladius) calvus Pinder. Ladle et al., 1985: 243–254 [biology].

Orthocladius (Euorthocladius) Pe1. Langton, 1984: 140, figs. 48b [in pupal key].

Spaniotoma (Orthocladius) thienemanni Kieffer. Edwards, 1929: 344, 345, fig. 6m.

Type Locality: England: Dorset, Waterston.

Type Material: Holotype (not seen). Male with associated exuviae, Dorset, Waterston experimental channel, 7 May 1981, J.A.B. Bass (BMNH). Assorted paratypes, BMNH and FBA (Pinder 1985).

Diagnosis:

Orthocladius calvus can be distinguished from other Holoarctic species of O. *(Euorthocladius)* by a combination of characters. Adult Male: high AR (1.73–2.08), palpal segment 3>4, and details of the hypopygium (Figs. 25, 26). Pupa: patch of straight thorn-like spines on tergite II (Fig. 37a) and rows of spines on posterior margins of tergites III–VIII. Larva: mentum with 13 teeth, MR>1.5, high AR (>2.00), and premandible bifid.

Derivation of Name: L. *calvus,* hairless. Pinder (1985) named this species for the absence of dorsal setae on the anal lobe of the pupa.

Description: See Pinder (1985).

Biology: Larvae are early colonizers of artificial recirculating streams where they inhabit gravel (Pinder 1985). For a detailed account of growth, development, and production of *calvus* see Ladle et al. (1985). Based on adult males, *Orthocladius calvus* occurs with *thienemanni* in the River Schwentine.

Distritution: Palearctic: England, Germany.

Material Examined: Paratypes. England, Dorset, Waterston Experimental Channel, 7-V-1981, coll. J.A.B. Bass, L.C.V. Pinder, 1M w/Ex, 1F w/Ex, 1L. Nontypes. England. Hitchin, Herts, 28-IV-1916, F. W. Edwards, 1916-105, 1 M (BMNH) (misident. of *thienemanni);* Gloucester, Minchinghampton, 16-IV-1893, Miss G. Ricardo, B. M. 1920-126, 1M (BMNH) (misident. of *thienemanni).* Germany. River Schwentine, East Holstein, 1935, leg. A. Thienemann, Schwentine 1935 S. 4, 1 M (ZSM) (misident. of *thienemanni).*

Remarks: Pinder (1985) described this species from several males and females with associated exuviae, and from larvae collected in an artificial recirculating stream system in southern England.

The adult males of *calvus* are very similar to *thienemanni* and will present problems in identification unless associated exuviae are available. The male of *calvus* can be distinguished from that of *thienemanni* by the relative lengths of palpal segments 3 and 4, and by the relatively straight margin of the dorsal part of the inferior volsella. Although this hypopygial character holds for the type material and one male from River Schwentine in Germany (Fig. 26), the margin in the *calvus* from Gloucester, England looks rounded (Fig. 25a) as in all *thienemanni* (Figs. 27, 28), and the margin in *thienemanni* from River Schwentine (Fig. 25b) looks like that in *calvus* (Fig. 26). The Herts material was identified as *O. thienemanni* by Edwards, but this material belongs to *calvus* based on the relative length of palpal segment 3 and 4. Brundin's (1956) figure of *O. thienemanni* looks like *thienemanni.*

The exuviae of *calvus* and *luteipes* (Figs. 46, 47) are morphologically similar; *calvus* can be distinguished by the central spine patch on the posterior margin of tergite II (Fig. 37a) and the less robust spines in the tergal spine rows (Fig. 37f) and shagreen. The bifid premandible of the larva is distinctive in *calvus.* However, whether or not the premandible is bifid is difficult to determine in *O. (Euorthocladius),* and has not been clearly established for most species.

Additions to Pinder's (1985) description include: Male. Head female-like, scutellars, biserial, sensilla chaetica absent in paratype male, present on ta1 of p2 in nontype male. Pupa. Pedes spurii A on IV or V to VII.

Orthocladius (Euorthocladius) coffmani n. sp.

Figs. 9, 34 a, 39

Orthocladius (Euorthocladius) species 2, Coffman & Ferrington, 1984: figs. 25.394, 25.395 [pupa].

Type Locality: USA Alaska, Portage.

Type Material: Holotype. Male pupa, USA, Alaska, Portage Glacial Pool, 20-VII-1977, #23, D. Wartinbee. Specimen dissected and parts placed in Canada balsam under 6 coverslips on a slide. Deposited in the FSCA. Paratypes (10). Canada. Alberta, Waterton Park, 21-VII-1967, A. L. Hamilton, A.3.1., 4 Ex (FWI). USA. Colorado, Gunnison Co., Beaver Dam on East R. 3.1 mi. N. of Gothic, 13-VII-1982, L. Ferrington No.-Co. #19, 3 Ex (KSBS). Idaho, East Fork Salmon River, 11-IV-1977, #PE 122, J. Sedell, 2 Ex (COFF). Montana, Beartooth-Absaroka Wilderness Area, 31-VII-1979, E.A. Wells, CH6965.1, 1FP (CNC).

Diagnosis:

Orthocladius coffmani can be distinguished from other Holarctic species of *O. (Euorthocladius)* by a combination of characters. Adult Male: palpal segment 3>4, multiserial scutellars, and details of the hypopygium (Fig. 9). Pupa: hooklets on II, large round patches of spines on III–VII, seta on anal lobe. Larva: Unkown.

Derivation of Name: This species is named after William P. Coffman, for providing associated material of this species and exuviae of other *Orthocladius* over the years.

Description

Adult Male (n=1)

Brown. Medium species. Head. Verticals 12, postorbitals 1. Palps long with 3>4. AR cannot be determined. Thorax. Lateral antepronotals 3. Acrostichals absent. Dorsocentrals 15. Prealars 5. Scutellars 16, multiserial. Wing. Squamals 20. Other characters cannot be determined. Legs. Measurements cannot be determined. Hypopygium (Fig. 9). Virga absent. Superior volsella collar-like. Inferior volsella with dorsal part squared and ventral part protruding like dorsal part, appearing double-lobed. Anal point weak with pointed apex. Crista dorsalis robust.

Variation. The virga is not visible, but it may be concealed in a mass of tissue.

Pupa (Exuviae)

Brown with darker apophyses on all tergites, and darker shading on cephalothorax and anal lobe. Length 3.7–4.8 mm (3). Cephalothorax. Frontal warts absent; cephalic tubercles weak; protuberances between bases of antennal sheaths below cephalic tubercles. Precorneals clumped, almost 3x as long as dorsocentrals; 1 median antepronotal, weak, 0 lateral antepronotals; 4 dorsocentrals, reduced spaced in a row. Thoracic horn (Fig 34 a) long, tubular, bubbled, light brown, length 220–310 μm. Thorax dorsally wrinkled along eclosion line.

Abdomen (Fig. 39). Tergites: I bare; II with large patch of recurved hooklets in about 15 rows; reduced patch of hooklets on III–V; III–VII with large circular patch of posteriorly-directed spines along anterior margin; patches of spinules on II–VIII. Sternites: I, IV, V bare, or at most with some spinules anteriorly; II, III with central patch of spinules along anterior margin; VI–VIII with 2 off-center patches of spinules anteriorly.

Setae on segments I–VIII:

D	4	4	5	5	5	5	5	1	L	1	3	3	3	3	3	3	3
V	2	2	2	3	3	3	3	1	Od	0	0	1	0	1	1	1	1

Anal lobe strongly developed into large, circular lobes; usually margin is smooth, at most margin is wrinkled along distal $^2/_3$; 1 ventral robust seta, on distal half. Pedes spurii A absent; pedes spurii B on II, weak. Genital sheaths extended beyond lobes in male, not in female.

Variation. Females appear larger than males.

Biology: Exuviae were collected from cold waters of mountain rivers and glacial pools. Adults emerge in April and July.

Distribution: Nearctic: Canada (Alberta); USA (Alaska, Colorado, Idaho, Montana)

Remarks: This species is a member of the *rivulorum*-group. The weak and pointed anal point is a distinguishing feature of the male, found only in one other species of O. *(Euorthocladius), abiskoensis.* The hypopygium resembles that of O. *(Orthocladius)* more than that of O. *(Euorthocladius).* The pupa may be confused with *rivulorum*, but the spine patches on tergites III–VIII are much larger in *coffmani.* In Coffman & Ferrington (1984), this species will key to couplet 45. The female and larva remain unknown.

Orthocladius (Euorthocladius) difficilis (Lundbeck)

Fig. 31

Chironomus difficilis Lundbeck 1898: 282 [description of male, female].

Orthocladius difficilis Lundbeck. Kertész, 1902: 217 [catalogue]. Johannsen, 1905: 267, 277 [in adult key; description of male, female].

Orthocladius (Orthocladius) difficilis Lundbeck. Andersen, 1937: 63 [in adult key].
Orthocladius difficilis (Lundbeck). Sublette & Sublette, 1965: 156 [checklist].
Orthocladius (Euorthocladius) difficilis (Lundbeck). Oliver, 1970: 103, 104, figs. 4–6 [designation and description of lectotype male].

Type Locality: Greenland; Kangersuak.

Type Material: Lectotype: Adult Male, Greenland, Kangersuak, 22/9/1890. Mounted in balsam under 5 coverslips on slide (UCOP). Typed label Chironomus *difficilis* Ldbk. Written LECTOTYPE, D. R. Oliver 1969. Red label with Type written; also date written.

Diagnosis

The male of *Orthocladius difficilis* can be distinguished from other males of *O. (Euorthocladius)* by the low AR and details of the hypopygium (Fig. 31). The pupa and larva are unknown.

Derivation of Name: L. *difficilis,* not easy, troublesome.

Description: See Oliver (1970).
Biology: Unknown.
Distribution: Nearctic: Greenland.

Material Examined: Lectotype.
Remarks: This species was reported in the literature primarily as occurring in Greenland, and was not identifiable until Oliver's (1970) redescription, where he also designated a lectotype and provided a figure of the hypopygium.
The male is a typical *O. (Euorthocladius)* with female-like eyes, biserial scutellars, crista dorsalis on gonostylus, and collar-like superior volsella. Acrostichals are absent.
This species is part of the *rivicola*-group, and the male can be distinguished from *thienemanni* by the lower AR (1.24 in *difficilis*, >1.80 in *thienemanni*) and from *rivicola* by salient features of the hypopygium. Both *rivicola* and *thienemanni* occur in Greenland, and specimens from Greenland were examined: a single male of *rivicola* (acrostichals present, AR=1.35) and exuviae of *thienemanni.*
The immature stages of *difficilis* are unknown. Rearings of *difficilis* from southwest Greenland are needed to better understand the species.

Orthocladius (Euorthocladius) kanii (Tokunaga)

Fig. 22

Spaniotoma (Orthocladius) kanii Tokunaga, 1939: 315–318, figs. 13, 36, 53, 54, 68, 76, 86, 91, 104, 114, 121, 131, 142, 157 [description of male, female, pupa, and larva]. Tokunaga, 1959; 1973: 641 [pupa, larva, fide Sasa & Yamamoto, 1977]. Thienemann, 1954: 345 [note].
"Spaniotoma (Orthocladius)" kanii Tokunaga. Thienemann, 1944: 567, 649 [in pupal, larval keys].
Orthocladius (sen. str.) *kanii* Tokunaga. Tokunaga, 1964: 17, fig. 4 [male, female].
Orthocladius kanii (Tokunaga, 1939). Sasa & Yamamoto, 1977: 310 [checklist].
Orthocladius (Euorthocladius) kanii (Tokunaga, 1939). Sasa, 1979: 26–28, figs. 40–43 [description of male, female, pupa, and larva]. Sasa, 1981:87 [survey record].

Type Locality: Japan: Kyoto.

Type Material: Holotype. Male, Japan, Kyoto, Nishigamo, Jan 1936, M. Tokunaga (2 white labels, printed). Abdomen from segment II to hypopygium mounted on a slide in Canada balsam under one coverslip by A.R. Soponis. Paratypes (?8). Same data as holotype, parts of males and females mounted in Canada balsam on 4 slides. Slide 1: hypopygium with abdominal segments VII, VIII. Slide 2: hypopygium with abdominal segment VIII. Slide 3: 4 coverslips, with 4 thoraces, 3 thoraces, 8 heads (4M, 4F), and parts of antennae, legs, thoraces. All type materials are retained in the Entomological Laboratory of Kyushu University. The only locality data in the vials were those of the holotype, and paratypes were assumed to have the same data. Paratypes from other dates and localities were not located.

Diagnosis

Orthocladius kanii can be distinguished from other species of *O. (Euorthocladius)* by a combination of characters. Adult Male: details of the hypopygium (Fig. 22); distinguishable from *luteipes* by distribution. Pupa: tergite II bare; rows of spines on margins of tergites IV–VIII; distinguishable from *rivicola* by distribution. Larva: mentum with 13 teeth, MR>1.5, low AR (<1.85); head capsule brown; distinguishable from *luteipes* by distribution.

Derivation of Name: This species was named for Mr. T. Kani, who collected the type specimens with M. Tokunaga (Tokunaga 1939: 318).

Description: See Tokunaga (1939) and Sasa (1979).

Biology: The larvae are widely distributed in torrential streams throughout Japan (Sasa, 1979: 28). The larvae live in oval, clear, gelatinous cases, 8–10 mm long, 4–5 mm wide, and 3–5 mm high, often covered with diatoms, and closely adhering to surfaces of stones on these streams (Tokunaga, 1939).

Distribution: Japan.

Material Examined: Type material.

Remarks: Tokunaga (1939) described this species from an unspecified number of males, females, pupae, and larvae collected in torrential streams in the suburbs of Kyoto, Japan. Sasa (1979) gave another detailed description of the species in all stages.

Orthocladius kanii is morphologically similar to *luteipes* in the adult male and larva. However the pupae are different: weaker spines occur in rows on IV–VIII in *luteipes*, whereas stronger spines occur in rows on IV–VIII in *kanii*; pedes spurii A are present on sternites V–VII in *luteipes*, and entirely absent in *kanii*. There was no opportunity to examine pupal material of *kanii*; however, detailed illustrations of the pupal abdomen (Sasa 1979, fig. 42b) and the pupal sternite VII (Tokunaga 1939, fig. 76) show no pedes spurii A. It is unlikely that both authors would have missed these prominent structures in their drawings. In addition, the tergal spine patterns of *kanii* more closely resemble those of *rivicola* than of *luteipes*. Thienemann (1954) remarked that he knew of no European parallel of *kanii*.

The extant type series, which contains only parts of male and female adults, was slide-mounted and examined. Variation of the hypopygium can be seen here (Fig. 22), and in Sasa (1979, fig. 41), Tokunaga (1939, fig. 36), and Tokunaga (1964, fig. 4). The figure in Tokunaga (1964) looks distorted and the specimens have a much higher AR (1.5–2.2) than that recorded for the species (1.4–1.7).

Orthocladius (Euorthocladius) luteipes Goetghebuer

Figs. 1, 23, 24, 37b, 46, 47, 53

Orthocladius luteipes Goetghebuer, 1938: 457, 458, fig. 6 [description of male]. Reiss, 1983: 176 [checklist]. Rossaro, 1984: table 2 [record].

Euorthocladius luteipes Goetghebuer. Thienemann, 1939: 6, 7 fig. 2b [description of pupa, larva]. Thienemann, 1944: 559, 648, fig. 14b [in pupal, larval key]. Thienemann, 1954: 347 [ecology].

Orthocladius (Orthocladius) luteipes Goetghebuer. Goetghebuer, 942: 34, 49, fig. 75 [description of male; in key to males].

"Orthocladius" luteipes G. Fittkau et al., 1967: 363 [checklist]. Fittkau & Reiss, 1978: 422 [checklist].

Orthocladius (Euorthocladius) luteipes (Goetghebuer). Rossaro, 1978b: 184, 185 fig. 1 [record, notes on males and species]. Langton, 1984: 144, fig. 49b [in pupal key]. Şahin, 1984: 81, figs. 203–205 [in larval key].

Orthocladius (Euorthocladius) Type III sp. Simpson & Bode, 1980: 13, 52 [partim] [larval description, photograph, in larval key].

Orthocladius (Euorthocladius) cf. *luteipes*. Coffman, 1973: Table 1 [ecology].

Orthocladius (Euorthocladius) species 4 Coffman & Ferrington, 1984: figs. 25.410, 25.411 [pupa].

Type Locality: Austria.

Type Material: Holotype. Male, Basse-Autriche, Dr. Mitis, TN18 (1938) (2 original ink labels of Goetghebuer), R. I. Sc. N. B. 18.073. Mounted on slide in Canada balsam under 2 coverslips by A. R. Soponis; in poor condition, body still pressed between celluloid.

Diagnosis

Orthocladius luteipes can be distinguished from other Holarctic species of *O. (Euorthocladius)* by a combination of characters. Adult Male: details of the hypopygium (Figs. 23, 24). Pupa: Pedes spurii A on sternites V–VIII; tergites IV–VIII with rows of slender spines on posterior margins. Larva: mentum with 13 teeth, MR>1.5, AR<1.85 (separable from *Kanii* by distribution).

Derivation of Name: L. luteus, yellow; most likely refers to the color of the adult male as described by Goetghebuer (1938).

Description

Adult Male (n=3)

Dark brown (OD: yellow with black bands, abdomen brownish). Medium species. Head. Verticals 16–20 (2), postorbitals 2–3 (2). Palps normal with 3≥4. AR 2.00 (1) (OD: 2.04). Thorax. Lateral antepronotals 2–5. Acrostichals 0–4, robust, begin within 2 AW. Dorsocentrals 6–11. Prealars 6–8 (2). Scutellars 15–18, biserial or multiserial. Wing. Length 2.15–2.58 mm (2). (OD: 2.15). R with 7–11 setae. Squamals 24–31. Anal lobe cannot be determined in my material (OD: produced). Legs. LR1 0.69 (1). LR2 0.48 (1). LR3 0.53 (1). (OD: LR1 0.78). Sensilla chaetica on ta1 of p2 (7–11) (2). Hypopygium (Figs. 23, 24). Virga present. Superior volsella collar-like. Inferior volsella with dorsal part squared, covering ventral part. Crista dorsalis long.

Variation. The acrostichals are missing on the type, and a single male specimen has sockets but no setae. Acrostichals are present on the male pupa. Rossaro (1978b) reported that *luteipes* has an average AR of 1.6 and an average wing length of 2.8 mm.

Pupa (Exuviae)

Light brown to brown with darker apophyses on I–VI, variable; some parts of conjunctives V–VI and VII–VIII darker. Length 3.50–5.00 mm (20). Cephalothorax. Frontal warts weak and cephalic tubercles absent. Precorneals weak, $1^1/_2$x as long as dorsocentrals; 2 median antepronotals, 1 lateral antepronotal, weak to strong; 3 dorsocentrals, robust, thicker than procorneals. Thoracic horn ellipsoid, light brown, filled or clear, stalked but not often seen; length 80–110 μm (20). Dorsum of thorax usually smooth, may be wrinkled or sculptured, expecially along eclosion line with granular pattern mesad of wing base.

Abdomen (Figs. 46, 47). Tergites: I–III bare; IV–VIII with rows of straight, slender spines along posterior margin (Fig. 37b); V–VIII with central patch of spinules, more extensive on each succeeding tergite; VII, VIII with spinules along anterior margin. Sternites: I bare; II–V with spinules on anterior half; VI–VIII with 2 off-center patches of spinules anteriorly.

Setae on segments I–VIII:

D	4	5	5	5	5	5	4	1	L	1	3	3	3	3	3	3	3
V	2	3	3	3	3	3	3	0	Od	0	1	1	1	1	1	1	0

Anal lobe greatly reduced, setae absent. Genital sheaths extended beyond lobe in male and female. Pedes spurii B absent; pedes spurii A robust, on V–VII.

Variation. Tergites may have sculpturing; pedes spurii A may be absent on V, VII, always present on VI. Setae are weak (Germany) to strong (Italy). Shagreen may be a small to large patch (Figs. 46, 47). Specimens are small (North America) to large (Europe). European specimens have more spines in spine patch IV–VIII than North American specimens. North American specimens have more dark apophyses than European. Posterior spine rows are absent from IV in one specimen from Germany.

Larva (Fourth Instar)

Body yellow. Head capsule brown. Eye spots bipartite or fused. Mentum (Fig. 53c) with 13 teeth, median tooth about 2x as wide as 1st lateral; MR 1.6–2.4 (6); median tooth as high as 1st lateral. Ven-

tromental plates extended anteriorly between 1st and 2nd laterals. Premandible simple, with notched apex. Chaetula laterales sparse. Mandible (Fig. 53 a) with apical tooth as long or slightly longer than 1st inner tooth; outer margin notched opposite seta subdentalis, rest of margin smooth except for occasional notch posteriorly; seta interna present. Antenna (Fig. 53 b) with robust Lauterborn organs; blade extended to 4th segment. AR 1.50–1.88 (6). Body with simple setae, most likely arranged like that of *saxosus*. Anal tubules long, rounded, with dorsal pair shorter and thicker than ventral pair.

Biology: This species has been collected from rivers and creeks. It occurs with *rivicola* in habitats in Oregon (South Santiam River) and Pennsylvania (Delaware River, Big Bushkill Creek, and Linesville Creek). Thienemann (1939, 1954) reported free-living larvae and pupae in gelatinous cases on stones. Adults emerge in April in Pennsylvania (Coffman, 1973), and generally from February through May.

Distribution: Palearctic: Austria, Germany, Italy, Turkey. Nearctic: USA (Georgia, New York, North Carolina, Oregon, Pennsylvania).

Material Examined: Type material. Non-type Material: Germany: Lunzer – 1940, 2-IV-40, A. Thienemann, 25 Ex; Partenkirchen 1933 No. 72, A. Thienemann, 1L, Mitis No. 19, 3L (ZSM). Italy: t. Ticiur, 26-3-1973, Rossaro, 1M; Brembo 2, 1-III-1980, Rossaro, 2Ex; T. Piovena, 3-II-1976, Rossaro, 1MP (ROSS). USA: Georgia, Fanin Co., Noontootla Cr. at Newport Rd., IV-24-1979, B. A. Caldwell, 1L (CALD). New York, Lewis Co., Black River nr. Port Leyden, 7-VII-1976, 1L; Niagara Co., Niagara R. nr. Youngstown, 6 Oct. 1976, 5L (NYSH). North Carolina, Iredell Co., Buffalo Shoals Creek, Jan 1981, K. Dechart, 1L (NCNR). Oregon, South Santiam River, 18 May 1977, PE462, W. P. Coffman, 1Ex (COFF); Echo Creek, 3 Oct. 1978, W. P. Coffman, #25, 4Ex (COFF). Pennsylvania, Monroe Co., Delaware River, n. of Party's Beach, 15 April 1976, #1, D. Wartinbee, 3Ex (COFF); same data except 9 May 1976, #3, 9Ex (COFF); Lineville Creek, 13-IV-1971, W. P. Coffman, 2Ex (CNC). Monroe Co., Big Bushkill Creek, Resica Falls, 17-IV-1976, 3Ex (COFF).

Remarks: Goetghebuer (1938) described this species in *Orthocladius* from a single male collected in Austria. The figure of the hypopygium, with a haired, pointed anal point and squared inferior volsella, resembles males of *Orthocladius (Orthocladius)*. Goetghebuer (1942) later reproduced the figure and description, and placed *luteipes* in his heterogeneous *O. (Orthocladius)*. He separated *luteipes* from similar species of the subgenus by the VR and extension of the R4+5 and Costa, characters that are usually too variable for species determination in *Orthocladius* (Soponis 1977). However, having to use these characters showed the difficulty of separating the adult male of this species, as does the key given here.

Not only is the male difficult to identify, but the type was virtually impossible to view because it was melted by Goetghebuer between 2 pieces of celluloid. Although the celluloid is not completely dissolved, the type can now be examined clearly, but it is in poor condition. The type does agree with Goetghebuer's (1938, 1942) illustrations.

Thienemann (1939) described the larva and pupa of *luteipes*, and distinguished them from *rivicola*, a species with which it is still confused today. Thienemann distinguished the pupa of *luteipes* from *rivicola* by the more slender spines of the more numerous rows on tergites IV–VIII, and the larger thoracic horn. In the material examined here, the thoracic horn of *luteipes* (80–110 μm, n=20) is larger than that of *rivicola* (45–70 μm, n=20). It is easiest to identify *luteipes* by the pedes spurii A on sternites V–VII, which Thienemann described but did not use in his key. Later, Thienemann (1944) included *luteipes* in his larval and pupal keys.

Simpson and Bode (1980), in their diagnosis of *O. (Euorthocladius)* type III sp. larva, provided a photograph of a larva of *luteipes* with MR>1.5 and AR of 1.73. Examination of their material showed that *rivicola* was also present.

Easily identifiable only in the pupal stage, *luteipes* has not been recorded frequently in the literature. Fittkau et al. (1967) and Fittkau & Reiss (1978) recorded *luteipes* in Limnofauna Europeae as an uncertain "*Orthocladius*". Rossaro (1978 b) illustrated the hypopygium and provided notes on *luteipes*. In Coffman & Ferrington (1984), the pupa will key to couplet 55.

Orthocladius luteipes belongs to the *rivicola*-group and is most easily determined by the exuviae. Males will be difficult to determine without associated exuviae. Altough the type and the male from Italy have a high AR (2.00, 2.04), Rossaro (1978 b) reported an average AR of 1.6 for *luteipes*. The pupae are easily separable from *rivicola* with the characters provided, and become distinctive when many specimens of both species are examined. The larvae are close to *thienemanni*, and *luteipes* can be distinguished by the wide median tooth (high MR) and lower AR.

This species occurs with other *O. (Euorthocladius)*, including *rivicola*, and has probably been misidentified as *rivicola* (pupa) and *thienemanni* (larva). Undoubtedly *luteipes* occurs more widely than documented here, although perhaps not as widely as *rivicola*, for example.

Orthocladius (Euorthocladius) rivicola Kieffer

Figs. 32, 33, 34 g, 37 c, 49, 55

Orthocladius rivicola Kieffer, 1911: 181 [original description; adult in key]. Thienemann, 1911: 637 [notes on pupa, locality data]. Thienemann, 1912: 74 [notes]. Potthast, 1914: 264, figs. 6–9 [pupa, larva]. Goetghebuer, 1932: 74, 88 [female, in key to females]. Thienemann, 1935: 203–205 [in pupal, larval key; synonymy]. Pankratova, 1970: 173, 174, 178, fig. 106 [in pupal, larval keys; pupal, larval descriptions]. Reiss, 1983: 176 [checklist]. Rossaro, 1984: table 2 [record]. Bitušík & Ertlová, 1985: 603, 606, table 2 [ecology].

Orthocladius (Chaetocladius) rivicola Kieffer. Goetghebuer, 1934: 89, 90, fig. 4 [male description].

Euorthocladius rivicola (Kieffer). Thienemann, 1936: 191 [record]. Thienemann, 1939: 7, fig. 2 a [pupa]. Thienemann, 1941: 65, 68, 78, 79, 82, 153, 180 [ecology, distribution]. Thienemann, 1944: 559, 648, fig. 13, 14 a, 195 [in pupal, larval keys]. Dittmar, 1955: 470, 481, 482, 484, table 30 [ecology]. Romaniszyn, 1958: 82 [in larval key]. Thienemann, 1954: 23, 31, 48, 49, 288, 301, 303, 333, 346, 347, 349, 355, 357, fig. 133 e.

Orthocladius (Orthocladius) rivicola Kieffer. Goetghebuer, 1942: 32, 53, fig. 87 [male description, in male key].

Orthocladius ex gp. *rivicola* Kieff. Chernovskii, 1949: 205, 282 [in larval key, synonymy].

Orthocladius (Euorthocladius) rivicola Kieffer. Brundin, 1956: 101 [record]. Fittkau et al., 1967: 362 [checklist]. Saether, 1968: 463 [ecology]. Saether, 1969: 61 [record]. Lehmann, 1971: 486 [ecology]. Kloet & Hincks, 1975: (V)15 [checklist]. Rossaro, 1977: 122 [notes]. Rossaro, 1978 a: 290, table 1 [distribution]. Rossaro, 1978 b: 185 [distribution]. Säwedal, 1978: 87 [record]. Fittkau & Reiss, 1978: 421 [checklist]. Prat, 1979: 67, 68, fig. 19 [male description]. Kownacki & Zosidze, 1980: 75, 79–81, table 2 [ecology]. Halvorsen et al., 1982: 119 [record]. Rossaro, 1982: 42–44 [in pupal, larval keys]. Mason & Lehmkuhl, 183: 207, fig. 19 [ecology]. Murray & Ashe, 1983: 230 [checklist]. Mason & Lehmkuhl, 1985: 878, table 1 [distribution]. Caspers & Schleuter, 1986: 323 [checklist].

Orthocadius (Euorthocladius) rivicola α. Rossaro, 1982: fig 31 [pupa].

Orthocladius (Euorthocladius) Thienemann type I. Soponis, 1977: 15–17, figs. 84 c, 90, 101, 120 [pupal, larval description; in pupal, larval keys].

Orthocladius (Euorthocladius) species 6 [partim]. Coffman & Ferrington, 1984: fig. 25.415 [pupa].

Orthocladius (Euorthocladius) cf. thienemanni-saxosus [partim]. Coffman, 1973: table 1 [ecology].

Orthocladius fusiformis Goetghebuer. Goetghebuer and Dorier, 1939: 30–32, fig. 1–5.

Type Locality: Germany.

Type Material: Could not be located, believed lost.

Diagnosis

Orthocladius rivicola can be distinguished from other Holarctic species of *O. (Euorthocladius)* by a combination of characters. Adult Male: lower AR (0.08–1.76), sensilla chaetica on midleg, and details of the hypopygium (Figs. 32, 33). Pupa: absence of pedes spurii A and hooklets on tergite II, presence of posterior spine rows on tergites IV–VIII, and normally developed dorsocentral setae; can be distinguished from *kanii* by distribution. Larva: mentum with 13 teeth, MR$<$1.5, AR$<$1.8; cannot be distinguished from *ashei.*

Derivation of Name: L. *rivus*, stream; L. cola, dweller, inhabitant.

Description

Adult Male (n = 27)

Small to medium species. Head. Verticals 9–20 (26), postorbitals 1–2 (21). Palps long with 3$>$4. AR. 1.00–1.76 (82). Thorax. Lateral antepronotals 1–9 (26). Acrostichals 0–10, weak, begin within 1 or more AW. Dorsocentrals 7–16. Prealars 4–7. Scutellars 8–26, often multiserial, also biserial, or multiserial. Wing. Length 1.30–2.80 mm (81). R with 2–9 setae. Squamals 10–36. VR 1.02–1.16 (25). Anal lobe slightly produced. Legs. LR1 0.61–0.75 (26). LR2 0.43–0.54 (26). LR3 0.47–0.59 (26). Sensilla chaetica (25) on ta1 of p2 (3–16). In addition, 3 specimens have sensilla chaetica on ta1 of p3, 2 (25). Hypopygium (Figs. 32, 33). Virga present or absent. Superior volsella collar-like or sightly triangular. Inferior volsella with dorsal part squared or rounded, and ventral part slightly extended below. Crista dorsalis long, robust.

Variation. The length of the terminal flagellomere is highly positively correlated with wing length in *rivicola* (r=+0.943, p>.001, n=80) as it is in most *Orthocladius* (Soponis 1977). However, wing length is not as highly correlated with either the length of the basal flagellomeres 1–12 (r=+0.747, p>.001, n=80) or with AR (r=+0.753, p>.001, n=80). Prat (1979) found a positive correlation between AR and wing length (WL 2.24 mm, AR 1.25; WL 3.00 mm, AR 1.6 to <1.8), and these were related to geographical locality. However, correlations with rations should be interpreted carefully and are not usually biologically meaningful (Soponis 1977).

In the 80 specimens measured, no obvious relatinship exists between wing length and locality. Considerable variation was found between specimens collected at the same locality, e.g. Trails Pond, Idaho, and at a general locality, e.g. Alaska. But little variation was also found between specimens collected at the same locality, Baffin Island.

The palps appear longer in some specimens, and for a small sample there is a fairly high positive correlation between interocular distance and total palpal length (r=+0.810, p>.001, n=14). In *rivicola*, at least, males with eyes more widely separated tend to have longer palps. Again, there was no apparent relation between locality and either of these two measurements.

Values from other studies of *rivicola* fall within the variation recorded in this material. AR: 1.40–1.50 (Rossaro 1978b); 1.50 (Lehmann 1971); 1.25–<1.80 (Prat 1979). Lower values of AR have been reported for high altitude specimens: 0.80 at 1100 m (Goetghebuer 1934) and 0.90, altitude presumably high (Rossaro 1978b). Rossaro (1978b) also reported 4–11 sensilla chaetica on ta1 of p2.

The hypopygium is highly variable, as seen here (Figs 32, 33), in Prat (1979), and in Goetghebuer (1934). In mature pupae (n=14), acrostichals were present or absent, and scutellars were uniserial, biserial, or multiserial.

Pupa (Exuviae)

Brown to pale brown, cephalothorax darker. Length 2.5–4.0 mm. Cephalothorax. Frontal warts and cephalic tubercles absent. Precorneals clumped, Pc1 usually longer and thicker than Pc2 and Pc3; 2 median antepronotals, 1 lateral antepronotal, 3 dorsocentrals, strong to weak, about as long as Pc1. Thoracic horn (Fig. 34g) small, ellipsoid, dark brown, filled or clear, stalked; length 45–70 μm (20). Thorax dorsally wrinkled along eclosion line.

Abdomen (Fig. 49). Tergites: I bare; IV–VIII with central rows of moveable straight spines along posterior margin (Fig. 37c); II–VIII with small patches of spinules anteriorly; IV–VIII with central patch of spinules anteriorly. Sternites: I bare; II–VIII with central patch of spinules anteriorly.

Setae on segments I–VIII:

D	4	4	5	5	5	5	5	1		L	1	3	3	3	3	3	3	2
V	2	3	3	2	2	3	3	0		Od	0	0	0	0	0	0	0	0

Anal lobe greatly reduced, with two seta, one on distal half and one at midpoint. Genital sheaths extended beyond lobe in males and females. Pedes Spurii A and B absent.

Variation. There is considerable variation in this widespread species. Spines in rows IV–VIII may be individually weak to robust; these spines may be in 1–5 rows on the tergites; spines may be spaced close together or far apart. The number of spines in the rows is higher in females than in males, but is not significantly different (t-test, p>.001*).

	rivicola females (n = 5)		*rivicola* males (n = 5)		Student's t*
IV	80.20 ± 21.19	(54–104)	48.00 ± 18.51	(36–80)	2.5590
V	79.60 ± 18.61	(60–100)	59.00 ± 19.87	(47–94)	1.6918
VI	69.80 ± 25.29	(44–103)	54.40 ± 13.99	(41–76)	1.19135
VII	57.40 ± 20.84	(39–90)	44.00 ± 15.95	(33–72)	1.1417
VIII	41.20 ± 19.80	(23–70)	29.60 ± 10.83	(20–47)	1.1491

Lehmann (1971) found two distinct types of *rivicola* pupae in the Fulda. One type had 2 or more rows of spines on the posterior margins of tergites IV–VIII, the other had only a single row of spines. In the Plön (now ZSM) collection he found many transitional forms between his two basic types, and he attributed these differences to intraspecific variation. It is possible that *ashei* was confused with *rivicola*, and *ashei* was the species with the single row of spines.

Setae on the abdomen are generally robust and easy to see in this species. Dorsocentrals can be forked or branched, weak to robust, but never as robust as in *ashei*. The thoracic horn can be filled or clear, small or large. The size of the thoracic horn is unreliable for distinguishing *rivicola* from *thienemanni* or *ashei*. However, all *luteipes* have larger thoracic horns than *ashei*, *rivicola*, and *thienemanni*.

There is considerable variation in the exuviae of *rivicola*. Several undescribed species may exist, including one from northwestern North America with individually robust spines on IV–VIII.

Larva (Fourth Instar)

Body yellow or brown. Head capsule brown. Eye spots fused. Mentum (Fig. 55d) with 13 teeth, median tooth about as wide as 1st lateral; MR 1.00–1.50 (7); median tooth as high or lower than 1st lateral. Ventromental plates extended anteriorly between 2nd and 3rd laterals. Epipharynx (Fig. 55a) with premandible simple. Chaetula laterales sparse. Mandible (Fig. 55b) with apical tooth as long or slightly longer than 1st inner tooth; outer margin notched opposite seta subdentalis, rest of margin smooth except for occasional notch posteriorly; seta interna present. Antenna (Fig. 55c) with robust Lauterborn organs; blade extended to 5th segment. AR 1.38–1.80 (7). Body with simple setae, some short and stiff, some long and curved, and arranged like *saxosus*. Anal tubules moderately long, rounded, with dorsal pair thicker than ventral pair.

Variation. The variation of the larvae is underestimated in this material. Consequently, larvae associated with pupae will be most accurately determined.

Biology: The larvae live on stones in currents of springs, brooks, streams, and rivers (Thienemann 1935, 1941, 1954; Dittmar 1955; Lehmann 1971). Larval and pupal tubes are similar to those of *thienemanni* (Fig. 40). Larvae usually live in individual gelatinous tubes covered with sand grains and detritus, cemented along their lengths to the stone. Pupae usually live in individual, clear, half-ellipsoid, gelatinous tubes with holes at both ends for the current. Larvae are rheobionts and eurytherms (Thienemann 1912, fide Dittmar 1955). Illies (1952, fide Dittmar 1955) found larves of *rivicola* in the mud, but such finds may be accidental for rheobionts like *rivicola*. Thienemann (1941, 1954) observed large numbers of free-living mature larvae and prepupae in submerged reeds (*Hydrurus*) collected in Switzerland.

Based on exuviae, *rivicola* occurs with *thienemanni* in at least 7 different sites: Ottawa River, Ontario, Canada; River Fulda, Germany; Linesville Creek, Pennsylvania; East Fork of Chattoga River, South Carolina; Fall Creek, South Carolina; Seneca Creek, South Carolina; and, Pigeon River, Tennessee. Bitůsík and Ertlová (1985) found *rivicola* and *thienemanni* in the River Rajčianka. They concluded that *rivicola* occurs in small numbers in every lotic zone studied, but *thienemanni* is largely confined to the 2. zone of high diatom density, occurring in high numbers. Kownacki & Zosidze (1980) found *rivicola* dominant in certain zones of rivers and streams of the Little Caucasus Mountains.

The adults emerge from November to May in Italy, and can be found at higher altitudes in July and August (Rossaro 1977, 1978a, b). Dittmar (1955) found adults in Germany from January to April. Thienemann (1954) found two generations in the Lunzer Gebiet: at the beginning of June, and from August to October. Lehmann (1971) recorded two emerging generations from the Fulda in Germany; the first from March to May/June, and the second in October/November. In Canada, Mason and Lehmkuhl (1938) found *rivicola* emerging from April to October, with only slight differences between emergence upstream and downstream of a hydroelectric development. In South Carolina, adults emerge from December to May.

This species also occurs at high altitudes and high latitudes (Thienemann 1936, 1941, 1954; Rossaro 1978b; Goetghebuer 1934).

Mites have been associated with *rivicola* (Thienemann 1954).

Distribution: Palearctic: England, France, Germany, Ireland, Italy, Poland, Sweden, Switzerland. Nearctic: Canada, Greenland, USA.

Material Examined: Non-type material: Austria. Lunz, Thienemann, 2M, 3Ex (ZSM). Bulgaria. Blagoevgrad, r. Bistriza, 28-II-1978, N. Natchev, 1Ex (NAT). Canada. Alberta: Waterton Natl. Park, 21-VII-1967, A. L. Hamilton, A.3.1, 4Ex (FWI); A. L. Hamilton and O. A. Saether, 1M, 1M w/Ex (FWI); Calgary, 4-VIII-1970, J. Martin, 1M (CNC). Manitoba: Duck Mtns, South Duck, 14-V-1980, 1M; 16-V-1980, 1M; Duck Mtns, Cowan G., 24-V-1980, 1M (FWI); Edwards Cr. Stn. 1, Riding Mtn. Natl. Pk., 50°59'15", 100°04'00", 4-VII-1975, 1M (CNC). Ontario (CNC): Ottawa, 21-X-1971, J. R. Downes, 1M; Ottawa, Central Expmntl Farm, 28-X-1966, J. Martin, 4M; Ottawa, Britannia Flitration Plant, 5-V-1971, D. R. Oliver, 1M; Ottawa, Ottawa R. Beach at Woodrufe, 9-V-1972, A. R. Soponis, 1M; Ottawa R. at Ottawa, 22-IV-1966, J. Martin, 1Ex; Ottawa, Ottawa R. at Rumic Rapids, drift, 16-IV-1985, P. S. Cranston, 13Ex; Green Creek, coll. 31-V-1979, em. 2-VI-1967, DRO, LHS, RDM, 1F w/Ex. Quebec (CNC): Ile Ste. Hélène, Montreal, 2-3-VII-1964, A. Nimmo, Shadfly Project, 1M; 16-17-VI-1964, 1M. Northwest Territories (CNC): Oscar Creek, 25-V-1972, FWI Pipeline Project, 2FP, 5MP; Trail R., 11-VIII-1972, FWI Pipeline Project, 1MP; Ft. Laird, 60°15'N 123°28'W, 5-VI-1973, D. R. Oliver, 1M; Bathurst Is., J. Bissett, 4-VIII-1977, 2M; 5-VIII-1977, 2M; 6-VIII-1977, 3M; 12-VIII-1977, 5M; Bathurst Is., 75°24'N 100°24'W, 25-VII-1984, B. Hayes, 1M w/Ex; Martin R., FWI Pipeline Project, 10-VIII-1972, 3M; 18-VIII-1972, 1M; Masik R., Banks Is., W. R. Mason, 18-VII-1968, 1M; Head of Clyde Inlet, Baffin Is., 7-VIII-1958, G. E. Shewell, 1M.

Yukon-Territory: Caribou Bar Creek, FWI-Pipeline Project, 19-VI-1972, 4M; 2FP, 1MP; 20-VI-1972, 2MP, 3FP, 15M; 12-VII-1972, 1M; J. Robillard, 18-VI-1973, 1M w/Ex, LS; Driftwood River, 19-VII-1972, 1L (CNC); Little Bear Creek, Mile 1022 Alaska Hwy, 3-VI-1978, D. R. Towns, 1M w/Ex (FSCA). Germany. Partenkirchen 125, 167, 94e, 1934, A. Thienemann, 5Ex (ZSM); Fulda, 10-III-1964, E. J. Fittkau, 1M, 1Ex, 1FP; Rhuhr, 8-V-11, bei Oloberg, A. Thienemann, 2MP, 1FP; Pullach, 26-II-1978, E. Ott, 1M w/Ex; River Isar, ca. 500 m oberhalb Loisach-Mündung, 3-IV-1986, F. Reiss, 5Ex (ZSM). Greenland. Nedre Midsommer So, 10-VII-1966, Can. Pearyland Expd., 1M (CNC). Italy. Po River, 1975, 1976, B. Rossaro, Ex; Brembo, 1-IX-1980, B. Rossaro, 3Ex, 1MP (ROSS); 21-VII-1980, 2M (ROSS). Norway. Ekse, HOi: Vaksdal, 9-VII-1979, E. Willassen, 1 reared M; same data except 11-VI-1979, 2 reared M; same data except 9-VII-1979, 1 reared M (ZMB). Sweden. Stordalen Sta., 7-VII-1958, D. R. Oliver, 3Ex (CNC); Lappland, 1936–1937, A. Thienemann, 2Ex, 1MP, 3FP (ZSM). Switzerland. Nationalpark Nadig, No 417, in Hydranus, A. Thienemann, 3FP, 1MP (ZSM). USA. Alaska: K. M. Sommermann, jeep trap (USNM): Palmer, VI-1964, 4M; Kenai Pen., Johnson L.-Soldatna, 19-VI-1965, 1M; Matanuska Eklutna Hwy, 22-VI-1964, 4M; Palmer-Anchorage Hwy., 22-VI-1964, 3M; Anchorage-Potter-Mt. Alyeska, 21-IX-1966, 2M; Anchorage-Eagle R.-L. Susitna R., 22-IX-1966, 7M; 24-IX-1964, 4M (USNM); Unnamed creek above Galbraith Camp 208075, 9-VII-1976, drift net, USGS, 2L, 1Ex (CALD). Arkansas: Benton Co., Prairie Cr., NW $^1/_4$, Sec. 2. T19N, R29W, 4-I-1963, O. A. Hite and L. K. Aggus, on bridge, 1M (SUB). Colorado: Delta Co., 1 mi. N Hotchkiss, 9-VIII-1971, M. Beard, at light, 1M (SUB). Georgia: Fannin Co., Noontootla Creek at Newport Rd., 24-IV-1979, B. A. Caldwell, 2L, 1M w/Ex (CALD); Stekoa Creek at Wolf Creek Rd. (Savannah R. Drng.), 13-X-1973, E. P. D., 1L (CALD). Idaho: Latah Co., Trails Pond, 7-III-1969, J. M. Gillespie, found on ice and vegetation, 8M (MINN). Kansas: Kiowa Co., Rezeau Ranch, spring fed creek, 19-III-1982, No. 31, B. G. Coler, J. K. Gelhaus, 17Ex (SBSK). Minnesota: Minneapolis, 4-VI-1969, D. E. Maschwitz, at light, 1M; Cook Co., Min. F. S. Hovland, 9-VI-1969, E. F. Cook NJ Mosquito Trap, 1M; Ramsey Co., St. Paul, 21-V-1968, R. A. Hellenthal, U of M vacuum trap, 1M; St. Louis Co., U of M Duluth, 6-VIII-1968, E. F. Cook, NJ Mosquito Trap, 1M (MINN). Montana: Hamilton, outside lab bldg., 19-III-1960, C. B. Philip, 2M (SUB); Rock Creek, 17-VIII-1974, W. P. Coffman, 2Ex (COFF). New York: Erie Co., Cazenovia Creek at East Aurora, 80 m upstream Mill Rd. bridge, multiplate sample, 29-VII-1976, K. W. Simpson, L (NYSH); Green Co., Gooseberry Creek nr. Tannersville, coll. 10-VI-1978, em. 11-VI-1978, R. W. Bode, scraped from rock, 1Ex w/wing (NYSH); Niagara Co., Niagara R. nr. Youngstown, 6-X-1976, L, 1Ex (NYSH); Rensselaer Co., Cropseyville, Route 2, Quackenkill Creek, 23-IV-1985, R. Bode, 3Ex (NYSH); St. Lawrence Co., St. Lawrence River nr. Waddington, 4-X-1977, L (NYSH); Ithaca, Apr., 1M (SUB). Tompkins Co., Ellis Hollow, 15-VI-1963, C. O. Berg, LT, 4M (USNM); Wash. Co., Hudson R. at Hudson Falls, 1km. upstrm. Bakers Falls dam, 8-VI-1976, K. W. Simpson, L (NYSH). North Carolina: Orange Co., Little River, II-1979, D. Lenat, S. Mozley, 1L (NCNR); Transylvania Co., Horsepasture R., 20-II-1976, P. Hudson, 2M (HUD); Wake Co., Cane Creek, II-1980, D. Lenat, S. Mozley, 1L (NCNR). Oregon: Aumsville, 22-II-1963, K. Goeden, light, 3M (USNM). Pennsylvania: Crawford Co., Lindesville Creek, 7-IV-1971, W. P. Coffman, 4Ex (CNC); same date except 13-IV-1971, 5Ex (CNC); stream nr. PA 285/I79 btwn. Cochranton and Geneva, 28-V-1975, #4, W. P. Coffman, 2Ex (COFF); Shawnee, stream, 4-IV-1976, #2, D. Wartinbee, 2Ex (COFF); Monroe Co., Big Bushkill Creek, Resica Falls, 17-IV-1976, 4Ex (COFF). South Carolina (HUD): Oconee Co., East Fk. Chattooga R., Nat. Fish Hatchery, 28-I-1981, P. L. Hudson, 4M; same data except 27-XII-1979, 1Mw/Ex; 15-II-1976, 1M w/Ex, 1M; Oconnee Co., Seneca, Fall Creek, Lake Keowee, 30-IV-1974, P. L. Hudson, 1Ex; same data except 10-X-1975, 1Ex; Oconee Co., Seneca Creek, 22-I-1976, 1FP, 2M, 1L; same data except 10-II-1977, 1MP; 26-III-1977, 1MP; 1-V-1977, 1MP; Oconee Co., Salem, Horsepasture River, 20-II-1976, P. L. Hudson, 3Ex; 18-XI-1977, 1M w/Ex; Pickens Co., Six Mile Creek, 4-II-1976, P. L. Hudson, 1M. South Dakota: Clay Co., Missouri R., Vermillion, 26-IV-1976, P. L. Hudson, channel, 1MP (HUD). Tennessee: Pigeon R., Gattlinburg, 3-V-1977, P. L. Hudson, 1Ex (HUD). Virginia: Falls Church, Holmes River, 17-VI-1960, W. W. Wirth, light trap, 1M (USNM). Washington: Benton Co., Hanford, Columbia R., D. R. Oliver, 20-III-1952, 1M w/Ex; 27-III-1952, 2MP; 3-IV-1952, 1M w/Ex (CNC); Yakima Co., 17-18-XII-1971, B. J. Landis, ex yellow water traps, 1M (SUB).

Remarks: Kieffer (1911) described this species in a key to adults of *Orthocladius*. He distinguished *rivicola* by the greenish-white abdomen, bare wings and veins, and cubitus not extended. He stated that the specimens were collected in Germany and were obtained by rearing the immature stages, which would subsequently be described by Thienemann. Kieffer did not mention the sex or number of specimens, nor did he designate a holotype. In correspondence between Thienemann and Kieffer, Kieffer wrote *Dactylocladus rivicola* nsp ♂♀ for specimens collected 8.IX.09 from Lenne bei Schmallenberg. This same material was cited by Thienemann (1911/12:74) as *Orthocla-*

dius rivicola Kieffer, so most likely this was the original material that Kieffer used to describe *rivicola*. A search of the ZSM collection resulted in no specimens from this locality that could qualify for lectotype designation. Specimens from other localities mentioned by Thienemann (1911/12:74) were also not found. Consequently a neotype for *rivicola* will not be designated here because this is not an exceptional circumstance (Rules of ICZN, Article 75 a), and suitable (reared) material from the type locality in Germany does not exist.

Goetghebuer (1932) briefly described the color and wings of the female of *rivicola*, and included the species in a key to females. Later Goetghebuer (1934) described the male of *rivicola*, and placed it in the subgenus *Orthocladius (Chaetocladius)*. He included characters of body length, wing variation, AR, and LR. The figure of the hypopygium shows the dorsal lobe of the gonocoxite rounded and in a low position, which closely resembles a male from Idaho (Fig. 33 a). Goetghebuer noted the similarity of the males of *rivicola* and *thienemanni*, and separated them by the high AR of *thienemanni* (2.00). The AR of 0.80 is low for *rivicola*, and this may be linked to high altitude. Later Goetghebuer (1942) reproduced essentially the same figure and description of the male, and placed it in *Orthocladius (Orthocladius)*.

Prat (1979) provided the most recent figure of the hypopygium of *rivicola*, which he distinguished from the male of *thienemanni* by the lower AR (1.50). Most Nearctic specimens have a more squared dorsal part of the basal lobe of the gonocoxite (Fig. 32, 33b) than Prat's figure.

The immature stages of *rivicola* have been recorded more often than the adults. Potthast (1914) described and figured the larva and pupa, and included the distribution. Potthast could not separate the larva of *rivicola* and *thienemanni*, but separated the pupae by differences in the spine rows and the larger thoracic horn of *rivicola*. In the material examined here, both species have similarly-sized thoracic horns (30–60 μm for *rivicola*, 30–70 μm for *thienemanni*).

Thienemann (1944) separated *rivicola* larvae from other *Euorthocladius* by the equally long anal tubules, low AR, small body length, and distribution. Chernovskii (1949) distinguished the *rivicola* group from the *thienemanni* group in his larval keys by the lower AR (1.10 versus 2.00) and the smaller body size (5 versus 8 mm). Romaniszyn (1958) uses AR and body length in his larval keys. Pankratova (1970) used Thienemann's figures, and separated the larvae of *rivicola* and *thienemanni* on the AR alone (1.40 versus 2.00) She also mentioned that the premandible was bifurcate and showed a crenulated margin on the mandible, characters not seen in this material. Soponis (1977) briefly described *rivicola* as *O. (Euorthocladius)* Type I and included it in subgeneric larval and pupal keys. Rossaro (1982) provided larval keys but did not separate *rivicola* from *luteipes*.

Thienemann (1939) distinguished the pupae of *luteipes* and *rivicola* by the stronger, shorter, darker, and denser spines in the posterior spine rows and the smaller thoracic horn of *rivicola*. Later, in his pupal keys, Thienemann (1944) used these same characters but he could not distinguish the pupae of *rivicola* and *fusiformis*. An exuviae of *fusiformis* determined by Dorier deposited in the ZSM collection was examined, and it is a good *rivicola*.

Pankratova (1970) did not distinguish between the pupae of *thienemanni*, *rivicola*, and *saxosus*.

Rossaro (1982) provided an excellent review of the Italian species in the subgenus with workable keys and figures of the species. He distinguished two forms of the pupae of *rivicola*, called α and β. Some of this material has been examined, and form α is *rivicola*, whereas form β is the new species *ashei*.

Coffman and Ferrington (1984) included *rivicola* in their pupal keys; *rivicola* will key to couplet 55.

Orthocladius (Euorthocladius) rivulorum Kieffer

Figs 20, 21, 34 b, 38 a, 51

Orthocladius rivulorum Kieffer, 1909: 48 [adult description]. Kieffer & Thienemann, 1909: 32 [notes]. Potthast, 1914: 264–266, figs 10–14 [larval, pupal descriptions]. Thienemann, 1935: 203, 204, fig. 1 [in pupal, larval keys, synonymy]. Pankratova, 1970: 173, 174, 178, 179, fig. 107 [larval, pupal descriptions]. Brennan et al., 1981: 149, table 2, 4 [ecology]. Reiss, 1983: 176 [checklist]. Rossaro, 1984: table 2 [record].

Orthocladius (Dactylocladius) rivulorum Kieffer. Goetghebuer, 1933: 215, 216, 218, figs 7, 7 a [description of male, female; in keys to males, females].

Spaniotoma (Orthocladius) rivulorum Kieffer. Johannsen, 1937: 56, 58, 62, 72, fig. 240 [in larval, pupal keys].

Euorthocladius rivulorum Kieffer. Thienemann, 1935: 201–204, fig. 1 [in pupal, larval keys, distribution, synonymy]. Thienemann, 1936: 191 [ecology]. Thienemann, 1944: 558, 648, figs 9, 11, 201 [in pupal, larval keys]. Thienemann, 1954: 23, 49, 108, 147, 191, 301, 303, 309, 344, 345, 347, 349, 356, 360, 670, figs 30, 142 a. Romaniszyn, 1958: 27, 82 [in larval key].

Orthocladius (Orthocladius) rivulorum Kieffer. Goetghebuer, 1942: 33, 53, fig. 88 [description of male, female, in key to males].

Orthocladius ex gp. *rivulorum* Kieffer. Chernovskii, 1949: 205, fig. 129a [in larval key].

Orthocladius (Euorthocladius) rivulorum Kieffer. Brundin, 1956: 101, fig. 64 [record]. Fittkau et al., 1967: 362 [checklist]. Saether, 1968: 464 [record]. Lehmann, 1971: 486 [ecology]. Lindegaard-Petersen, 1972: 482 [ecology]. Fittkau & Reiss, 1978: 421 [checklist]. Pinder, 1978: 70, figs 35 G, 111 B [in key to males]. Rossaro, 1978a: 290, table 1 [ecology]. Rossaro, 1978b: 185 [ecology]. Kownacki & Zosidze, 1980: table 2 [ecology]. Cranston, 1982: 102, fig. 39e [in larval key]. Drake, 1982: 234, fig. 6 [ecology]. Rossaro, 1982: 42, figs 30, 31 [in pupal, larval keys]. Murrary & Ashe, 1983: 230 [checklist]. Langton, 1984: 142, fig. 49a [in pupal key]. Sahin, 1984: 80, figs 198, 199 [larval description, in larval key].

Hydrobaenus rivulorum ? (Kieffer). Roback, 1957a: 76, 80, figs 183, 184 [in pupal, larval keys].

Orthocladius (Euorthocladius) sp. 1 Oliver et al., 1978: 18, fig. 167 [in larval key].

Orthocladius (Euorthocladius) cf. *rivulorum-suspensus*. Coffman, 1973: table 1 [ecology].

Orthocladius (Euorthocladius) Alaska sp. III Tilley, 1979: 138, 139, fig. 8 [larva).

Orthocladius (Euorthocladius) species 1 Coffman & Ferrington, 1984: figs 25.391–25.393 [in pupal key].

Orthocladius (Euorthocladius) sp. Coffman & Ferrington, 1984: fig. 25.203 [in larval key].

Chironomus (Orthocladius) sordidellus Zetterstedt sensu Taylor, 1903: 521–523, figs 1, 2 [ecology] [misidentification].

Orthocladius sordidellus Zetterstedt sensu Kieffer & Thienemann, 1906:148, 152, 153, figs 7–9 [misidentifikation].

Type Locality: Germany, Ennepe, in Westphalia.

Type Material: Lectotype: A single female exuviae, labelled by Thienemann as Ennepe, *Orthocladius sordidellus*, then later labelled by Thienemann as *Orthocladius rivulorum* n.sp. These two labels were the only labels on the slide. The lectotype is circled on the slide as the lower exuviae under the right cover slip when the labels are on the left side. A paralectotype female exuviae is under the same coverslip: a damaged male exuviae (non-type material) is under a broken cover slip on the same slide.

Based on Thienemann's correspondence it's certain that this is the material associated with the adult females that Kieffer (1909) used to describe *rivulorum*. In a letter sent to Kieffer dated 17-VI-1908 Thienemann wrote: „*Orthocladius sordidellus*, Ennepe, dicht unter der Sperre 5.VI.08, Gallertgehause wie sie von Taylor u. Lauterborn beschrieben". Kieffer's answer written in the same letter, in his own handwriting, was "*Orthocladius rivulorum* n.sp. ♀". According to Opinion 1147, Ruling 1 (ICZN 1981), this material qualifies for lectotype designation. I am hereby designating this material described above as lectotype and paralectotype. There was no other material from Ennepe collected by Thienemann in the ZSM.

Diagnosis

Orthocladius rivulorum can be distinguished from other Holarctic species of *O. (Euorthocladius)* by a combination of characters. Adult Male: lower AR (1.30) and details of the hypopygium (Figs 20, 21). Pupa: hooklets along posterior margin of tergite II, small round spine patches on tergites III–VIII, and bubbled thoracic horn. Larva: 17–21 teeth on mentum, weak Lauterborn organs, squared head capsule, isolated 4th tooth of mandible, slender shape of mandible, and distribution.

Derivation of Name: L. *rivulus*, a small brook.

Description

Adult Male (n = 4)

Brown (O. D.: yellow body with black bands). Medium to large species. Head. Verticals 12–16, postorbitals 0–4. Palps long with 3›4 (1). AR 1.29–1.30 (2). Thorax. Lateral antepronotals 5–9 (3). Acrostichals absent. Dorsocentrals 5–9. Prealars 4–5 (3). Scutellars 15–27, biserial to multiserial. Wing. Length 2.05–2.38 mm (2). R with 6–9 setae (2). Squamals 21–31 (3). VR 1.11–1.12 (2). Anal lobe slightly produced. Legs. LR1 0.73 (2). LR2 0.50–0.53 (2). LR3 0.55–0.56 (2). Sensilla chaetica on ta1 of p2, 7–8 (2) and p3, 7–8 (2). Hypopygium (Figs 20, 21). Virga present but difficult to see. Superior volsella collar-like. Inferior volsella with dorsal part arched convexly, nose-like, and ventral part covered or slightly extended below.

Variation. The variation in the adult male is not understood. Apparently the immature stages of *rivulorum* are recognized more often than the adults. The reared male from Ireland (Fig. 20) is typical of this species.

Pupa (Exuvia)

Light brown; apophyses on I–VI, variable; length 2.5–4.3 mm. Cephalothorax. Frontal warts weak or absent; cephalic tubercles absent. Precorneals spaced from each other evenly, 2–3x as long as dorsocentrals; 2 median antepronotals, 0 lateral antepronotals, 4–5 dorsocentrals, weak but often with large sockets; spacing variable (1–1–1–1, 1–1–2, 2–1–1, 2–2). Thoracic horn (Fig. 34b) long, tubular, filled, with bubbled surface; length 170–260 μm. Thorax dorsally smooth with some sculpturing and/or rugosity mesad of wing base and posteriorly along eclosion line.

Abdomen (Fig. 38a). Tergites: I bare; II–V with median patch of recurved hooklets along posterior margin; III-VII with small anterior circular patch of posteriorly-directed spines; on VIII a patch is indicated; IV–VI with strong spines in horizontal patch on either side of medial patch; anterior patch of spinules on II-VIII, most extensive on VI–VIII. Sternites: I, VIII bare; II–III with central patch of spinules anteriorly; IV, VII with spinules anteriorly; VIII with 2 off-center patches of spinules anteriorly.

Setae (weak) on segments I–VIII:

D	3	5	5	5	5	5	5	2		L	1	3	3	3	3	3	3	4
V	2	2	3	3	3	3	3	1		Od	0	1	1	0	1	0	1	0

Anal lobe strongly developed into large, circular lobes; setae absent. Genital sheaths slightly extended beyond lobe in male, not in female. Pedes spurii B on II; pedes spurii A absent.

Variation. The patches of hooklets are moveable. The arrangement of the dorsocentrals is variable. The thoracic horn can be weakly or strongly bubbled.

Larva (Fourth Instar)

Body yellow, brown, or green. Head capsule brown; preserved, yellow. Eye spots bipartite or fused. Head capsule (Fig. 51f) squared. Mentum (Fig. 51e) with 17–21 teeth, usually 19; median tooth more than 4x as wide as 1st lateral; MR 4.8–8.5 (10); median tooth much higher than 1st lateral. Ventromental plates extended anteriorly between 2nd and 3rd laterals, less commonly between 1st and 2nd or between median and 1st. Epipharynx (Fig. 51a) with premandible simple, slender, and similar to that in *Orthocladius (Orthocladius)*. Cheatula laterales full, moustache-like. Mandible (Fig. 51c) with apical tooth longer that combined length of 3 inner teeth; 4th tooth separated by space from rest of mandible; outer margin notched opposite seta subdentalis; rest of margin smooth except for small notch posteriorly; seta interna present. Antenna (Fig. 51b) with moderately developed or weak Lauterborn organs; blade extended to 5th segment. AR 1.88–2.22 (8). Body with simple, single setae and possibly arranged like that of *saxosus*. Anal tubules long, rounded, subequal, with dorsal pair thicker than ventral pair.

Variation. Chernovskii (1949) and Pankratova (1970) reported an AR of 2.5.

The number of teeth on the mentum are highly variable. Based on figures in the literature, these numbers of teeth were counted: 17 (Tilley 1979; Sahin 1984); 18 (Romaniszyn 1958; Coffman & Ferrington 1984; Cranston 1982); 19 (Potthast 1914, reproduced in Thienemann 1944, Chernovskii 1949, Pankratova 1970; Johannsen 1937); 21 (Oliver et al. 1978, Rossaro 1982); and 23 (Kieffer & Thienemann 1906). In 18 examined specimens, the number of teeth on the mentum were: 21 (3), 20 (1), 19 (10), 18 (2), and 17 (2). Sometimes the number of teeth are not symmetrical (here, and cf. Coffman & Ferrington 1984). Whether the variation in mental teeth is due to instar age, species differences, or other factors remains to be determined.

Biology: The larvae usually live on stones and sometimes on moss in fast flowing waters of brooks, streams, and rivers (Thienemann 1935, 1936, 1954). The gelatinous, cylindrical larval tube is attached

to the substrate at one end, and is often overgrown with one or more species of diatoms (Taylor 1903, Lauterborn 1905, Thienemann 1954). The tube is transformed into a pear-shaped pupal case, suspended by an anchor at one end (Fig. 51 d). Mites and mermithids have been found associated with *rivulorum* (Taylor 1903, Thienemann 1954).

The adults emerge during the winter or early spring. They emerge March to May in the Fulda, Germany (Lehmann 1971); May in Denmark (Lindegaard-Petersen 1972); November, February and April in Italy (Rossaro 1978 a, b); and April and May in Pennsylvania, USA (Coffman 1973).

This species also occurs at high altitudes; e.g. alpine brooks (Thienemann 1936, 1954).

Distribution: Palearctic: Austria, Denmark, England, Germany, Ireland, Poland, North Africa (Lehmann 1971), Norway, Sweden, Switzerland, Turkey. Nearctic: Canada, USA.

Material Examined: Lectotype and paralectotypes. Non-type material: Canada (CNC). Quebec: R. Blanche, S. of Perkins, 9-V-1972, A. R. Soponis and J. Robillard, 1MP. New Brunswick: Kouchibouguac Nat'l Park, 30-V-1978, D. R. Oliver and M. E. Roussel, 1M. N. W. T.: Oscar Creek, 25-V-1972, FWI Pipeline Project, 1L. Yukon Territory: (FWI Pipeline Project) Bluefish River, 14-VIII-1972, 2L; Old Crow River, 25-V-1972, 2L; Driftwood River, 16-VIII-1971, 1L; Lord Creek, 19-VII-1972, 1L; Caribou Bar Creek, 20-VI-1972 1L; 10-VIII-1972, 1L. Denmark: Jutland, Linding Å., 14-V-1964, Claus Lindegaard: 14-V-1964, 1L; 22-V-1965, 1F; 3-VII-1968, 1F; V-1968, 1Ex; 20-V-1969, 2L (UCOP). England: East Sussex, Marsh Green, 17-IV-1978, P. S. Cranston, 5L (BMNH); Tadnoll Brook, 17-V-1976, L. C. V. Pinder, 1 reard M, 1 reared F (FBA). Germany. A. Thienemann: Bach Kossau, Ostholstein, IV-1936, 1Ex; Partenkirchen, Oberbayern, 3L (ZSM). Ireland. River Flesk, Clydagh Bridge, drift, 16-19-V-1978, P. Ashe, 1M w/Ex (DUB). Italy. (B. Rossaro, ROSS): Brembo, 16-III-1981, 3L, 1Ex; 23-XII-1975, 3L; 9-I-1980, 1Ex; Lot Entraygnes passerelle, 22-IX-1977, 1Ex; 26-II-1979, 1Ex. USA. Arkansas: Wash. Co., Tuttle Branch off Rt. 74, 10-I-68, Allen and Fuller, 1M (INHS). Colorado: Arapahoe Co., S. Platt River, 5-XI-1981, M. W. Heyn, 2L (HEY); same locality, 6-XI-1981, P. Guthrie, 1L (GUT). Minnesota (MINN): Cook Co., Min. F. S. Hovland, N. J. Mosquito Trap, 13-V-1968, E. F. Cook, 1M; Mississippi River, Montecello, 19-II-1976, 1M; same locality, 23-II-1978, 1M North Carolina: Mitchel Co., N. Toe River, 2-II-1978, K. Dechart, 3L (NCNR). Oregon: Metolius River, 3-X-1978, W. P. Coffman, 4Ex (COFF). Pennsylvania: Crawford Co., Linesville Creek, 13-IV-1971, W. P. Coffman, 2Ex, (CNC); 7-IV-1971, 2Ex (CNC); 6-V-1971, 2Ex (CNC); Delaware River, 9-V-1976, D. Wartinbee, 6Ex (COFF); Monroe Co., Big Bushkill Creek, Resica Falls, 17-IV-1976, 1Ex (COFF). South Carolina: Oconee Co., Horse Pasture River, Salem, 17-III-1977, P. L. Hudson, 1M (HUD).

Remarks: Kieffer (1909) described this species from Germany using adult specimens reared by Thienemann. He separated *rivulorum* from *O. pedestris* by the wings, yellow body with black legs and black markings, cubitus not extended, and non-branched antennal sensillae, adding that the larvae live in gelatinous tubes. He did not provide figures, he did not mention how many specimens he had, and he did not designate a holotype.

Goetghebuer (1933) placed *rivulorum* in *Dactylocladius* based on the adult characters, and provided the first figure of the hypopygium and female antenna, as well as a more complete description. He used characters such as body length, AR, LR, wing venation, and hypopygium. In his material the AR was about 1.00. In his figure of the hypopygium, the anal point is not haired, although the drawing looks like *rivulorum*. However, the examination of several Goetghebuer types shows that Goetghebuer did not always draw setae on the anal point when present. Later, Goetghebuer (1942) essentially reproduced the same hypopygial figure and description, and included the male in a key with AR of 1.00.

Brundin (1956) included *rivulorum* in his subgenus *Euorthocladius* and provided a more accurate figure of the hypopygium, with haired anal point and slight crista dorsalis. Pinder (1978) provided the most recent figure of the hypopygium, and included *rivulorum* in his key to males of Britain.

The tubes of the larva and pupa of *rivulorum* were described as belonging to *Chironomus (Orthocladius) sordidellus* by Taylor (1903, figs. 1, 2) and to an unnamed chironomid by Lauterborn (1905, fig. 15). Taylor's figures were reproduced in Thienemann (1954, fig. 30) and here (Fig. 51 d).

Potthast (1914) described the larva and pupa of *rivulorum*, along with its habits, and provided figures of the mandible, mentum, proleg claws, exuviae, and thoracic horn. In his figure of the exuviae, tergite II appears bare. The patch of recurved spines on II most likely overlapped with the rounded spine patch of III (cf. Fig. 38 a).

Thienemann, in Kieffer & Thienemann (1906), provided a figure of the mentum, mandible, pupal spines, and setae of *rivulorum*. He treated the immature stages as *sordidellus*, based on the description of the larval and pupal tubes by Taylor (1903). Thienemann compared his material with the descriptions of the immature stages of *sordidellus* by Johannsen (1905), who actually described a species of *Orthocladius (Orthocladius)*. Within a few years, Kieffer & Thienemann (1909) knew they had *rivulorum* and not *sordidellus*.

Thienemann (1935) placed *rivulorum* in his genus *Euorthocladius*, and gave synonymy, distribution, and keys to larvae and pupae. He distinguished the larvae by the 8–9 pairs of lateral teeth on the mentum, unequal apices of SI, moustache-like epipharynx, and unique tubes. He distinguished the pupae by the spines on tergites III–VIII, tho-

racic horn, and unique tubes. Thienemann (1944) used these characters in his keys. He distinguished the larvae of *rivulorum* from those of *suspensus* by distribution; the pupa, by the thoracic horn and spine patterns.

Johannsen (1937) used the thoracic horn and 8–9 pairs of lateral teeth on the mentum to distinguish the immature stages in his keys, and Roback (1957a) largely followed him, and figured the simple premandible.

Chernovskii (1949) included *rivulorum* in his larval keys, and noted an AR of 2.5, green body color, and body length of 5 mm. Romaniszyn (1958) reproduced the figures of Potthast (1914) and distinguished *rivulorum* by the 8–10 pairs of lateral teeth on the mentum. Pankratova (1970) also reproduced Potthast's (1914) figures and used the 9 lateral teeth on the mentum and the long thoracic horn to distinguish *rivulorum* in her larval and pupal keys. She recorded the larval body as brown, the AR as 2.5, and the premandible as bifurcate.,

Oliver et al. (1978) included *rivulorum* as O. *(Euorthocladius)* sp. 1 in a key to larvae, with a photograph of the mentum.

Rossaro (1982) included the larva and pupa of *rivulorum* in his keys, and provided figures. He distinguished the larvae by the 8–10 lateral teeth on the mentum and the moustache-like epipharynx, and the pupae by the spines on III–VIII. Sahin (1984) included *rivulorum* in his larval keys, along with figures of the mentum and mandible. Coffman & Ferrington (1984) included the pupa and larva in their keys; the pupa keys to couplet 45, the larva keys to couplet 43.

Orthocladius (Euorthocladius) roussellae n.sp.

Figs. 11, 13–15, 34c, 34d, 41, 50

Orthocladius (Euorthocladius) type II Soponis, 1977: 15, 17, figs. 20, 84e, 92, 100, 121, 107b [larval, pupal descriptions; in larval, pupal keys].
Orthocladius (Euorthocladius) species 3 Coffman & Ferrington, 1984: figs. 25.406, 25.407 [in pupal key].
?*Orthocladius (Euorthocladius)* sp. Ferrington, 1984: table 7 [drift].

Type Locality: Canada, Northwest Territories, Axel Heiberg Island.

Type Material: Holotype. Male, Canada, NWT, Axel Heiberg Island, 79°25'N, 90°45'W, Gypsum Hill, 20-VII-1963, H. K. Rutz, CH3635 (CNC). Paratypes (78). (From CNC unless indicated otherwise). Canada. Alberta, Highwood Pass, 16-VII-1977, D. R. Oliver, CH7131, 1FP w/LS, 1 M w/Ex,LS, 1 F w/Ex,LS; Marmot Creek, 29-VI-1977, D. R. Oliver, CH7079, 1MP w/LS, 2FP w/LS. Northwest Territories. Melville I., Bailey Point, J. E. H. Martin: 27-VII-1965, CH25, 3M; 24-VII-1965, CH23, 1M; 20-VII-1965, CH21, 3M; 25-VII-1965, CH27, 1M. Baffin I., Head of Clyde Inlet, 7-VIII-1958, G. E. Shewell, CH1162, 3M; Frobisher Bay, 5-VIII-1948, F. G. Dilabio, CH3653, 1M; Banks I., Masik R., 9-10-VII-1968, W. R. Mason, CH265, 1FP w/LS; Axel Heiberg I., H. K. Rutz, 21-VII-1963, CH 1164, 1M; Slop E, 7-8-1963, CH3656, 3M; Expedition R., 26-VII-1963, CH3634, 4M; 4-VIII-1963, CH1281, 3M; Creek SE Gypsum Hill, 21-VII-1963, CH 1164, 2M; Hazen Camp, 81°49'N, 71° 18'W, D. R. Oliver: 14-VIII-1961, CH3619, 7M 5-VIII-1961, CH3329, 6M; 1M (ZMB); CH3631, 1 male; NE217, 11-VIII-1961, CH3649, 1M, 1MP; 31-VII-1961, CH3594, 1M; Alert, 24-VIII-1963, D. R. Oliver, CH3627, 4M; Alert, Parr Creek, 25-VIII-1963, D. R. Oliver, CH3627, 3MP, 6Ex. Greenland. Nedre Midsommer So, Can. Pearyland Expd.: 16-VII-1966, CH 3632, 2M, 19-VII-1966, CH1102, 2M, CH1417, 1M. USA. Alaska. Portage Glacier-Pool, 20-VII-1977, #16, D. Wartinbee, 3Ex (COFF). Wyoming, Inlet Run to Frozen lake, algal mats, 8-VIII-1981, W. P. Coffmann, #3, 3Ex, #8, 4P, 4LS (Coff).

Diagnosis

Orthocladius roussellae can be distinguished from other Holarctic *Euorthocladius* by a combination of characters. Adult Male: low AR (1.02–1.56), numerous and multiserial scutellars, numerous lateral antepronotals and prealars, and details of the hypopygium (Figs. 11, 14, 15). Pupa: spines on the tips of anal lobe, hooklets along posterior margin of tergite II, and the long, tubular thoracic horn. Larva: mentum with 15 teeth, premandible bifid, Lauterborn organs weak, and mandible without seta interna.

Derivation of Name: This species is named after my friend Mary E. Dillon, formerly Mary E. Roussel.

Description

Adult Male (n = 24)

Dark brown. Large species. Head. Verticals 11–30, postorbitals 1–5. Temporals doubled or clumped medially by coronal suture (Fig. 13). Palps long with 3›4. AR 1.02–1.56. Thorax. Lateral antepronotals 9–27. Acrostichals 1–23, robust, beginn within 1 or 2 AW. Dorsocentrals 6–21, sometimes biserial. Prealars 6–18. Scutellars 25–60, multiserial. Wing. Length 2.52–3.35 mm. R with 6–12 setae. Squamals 19–37. In one specimen, 1 seta on R4+5. VR 1.00–1.08. Anal lobe produced. Legs. LR1 0.68–0.72. LR2 0.46–0.56. LR3 0.55–0.60. Sensilla chaetica on ta1 of p3 (6–18, 21). Hypopygium (Figs. 11, 14, 15). Virga absent or, if present, weakly developed, often difficult to see. Superior volsella collar-like. Inferior volsella with dorsal part long or short, rounded or square, covering ventral part. Crista dorsalis long.

Variation. There is not a high correlation between interocular distance and total palpal length ($r=+0.641$, $p>0.02$, $n=15$).

Pupa (Exuviae)

Brown, with darker apophyses on II–VII, variable. Length 4.6–6.5 mm (10). Cephalothorax. Frontal warts moderately developed, cephalic tubercles weak or absent. Precorneals clumped, 2x as long as dorsocentrals; 2 median antepronotals, 1 lateral antepronotal, 4 dorsocentrals, weak, arranged 1–1–2 or 2–2. Thoracic horn tubular, bare, brown, with expanded base usually smooth (Fig. 34 d); sometimes collapsed (Fig. 34 c) or partially bubbled; length 230–440 μm. Thorax dorsally extensively rugose.

Abdomen (Fig. 41). Tergites: I bare; II with large central patch of recurved hooklets in 5–6 rows along posterior margin; III–V with central patch of spines anteriorly, separated from small horizontal patch of spines along posterior margin; VI as V but without posterior patch; large patch of spinules on III–VI, small patch of spinules along anterior margin on VII, VIII. Sternites: I with spinules laterally; II–IV with large central patch of spinules; V–VIII with 2 off-center patches of spinules anteriorly.

Setae on segments I–VIII:

D	3	5	5	5	5	5	5	2	L	2	2	3	3	3	3	4	4
V	2	3	3	4	4	4	4	1	Od	0	0	1	1	1	1	1	1

Anal lobe slightly extended with heavy spines on tips; 3 dorsal setae, 2 at midpoint, often branched, and one on inner margin of distal half. Genital sheaths extended beyond lobe in male, not in female. Pedes spurii B on II, III, developed with tubercles; pedes spurii A on IV–VI.

Variation. Sculpturing occurs on tergites VII, VIII. On one male pupa there are 5 L setae on VII. In the three exuviae from Alaska (COFF) the thoracic horns have the surface partially collapsed and bubbled, but not bubbled as uniformly as in *rivulorum* (Fig. 34 b).

Larva (Fourth Instar)

Body yellow or brown. Head capsule dark brown. Eye spots bipartite or fused. Mentum (Fig. 50 e) with 15 teeth, median tooth as wide or slightly wider than 1st lateral (Fig. 50 d); MR 1.2–1.5 (7); median tooth as high or lower than 1st lateral. Ventromental plates extended anteriorly between 1st and 2nd laterals. Epipharynx (Fig. 50 a) with premandible bifid. Chaetula laterales sparse. Mandible (Fig. 50 c) with apical tooth as long or longer than 1st inner; outer margin notched opposite seta subdentalis and crenulated on posterior half on margin; rest of margin smooth, except for notches posteriorly; seta interna absent. Antenna (Fig. 50 b) with weak to moderately developed Lauterborn organs; blade extended to 5th segment. AR 2.08–3.08 (14). Body with simple setae, short and stiff and long and curved, at least on I, II; arranged most probably like those in *saxosus* (Fig. 57). Anal tubules long, rounded, subequal.

Variation. The anterior extension of the ventromental plates is difficult to determine in this species. It merges into thickenings of the mentum and appears to end between the 1st and 2nd laterals.

Biology: Reared larvae were collected from creeks (Alberta) and rivers (NWT), and from algal mats in an inlet run to a lake (Wyoming).

Distribution: Nearctic: Canada, Greenland, USA.

Additional Material Examined: Northwest Territories: Axel Heiberg Island, 4M; no label, 1M. Yukon Territory: Caribou Bar Creek, 5L. Alaska: 2L.

Remarks: This species could be confused in the adult male with two sympatric species possessing remarkably similar hypopygia, O. *(Orthocladius) frigidus* and O. *(Pogonocladius) consobrinus*. The male of *roussellae* can be distinguished from *frigidus* by the female-like eyes, and from *consobrinus* by the numerous, multiserial scutellars, absence of a fore tarsal beard, and the normally produced anal lobe of the wing. The clumped temporals will separate males of *roussellae* from most males of *frigidus* and *consobrinus*. However, at least one *frigidus* and one *consobrinus* were examined that have clumped, multiserial temporals instead of the normal uniserial arrangement.

Orthocladius roussellae occurs with *frigidus* primarily in mountains of temperate regions, and with *consobrinus* in the high arctic. The immature stages of these three species are easily separable.

Soponis (1977) incorrectly stated certain characters of the new species. For pupae, PSA occur on IV–VI, not on IV–VII; frontals are absent, not present. For larvae, the seta interna of the mandible is absent, not present.

Coffman and Ferrington (1984) included the pupa in their keys; *roussellae* will key to couplet 53.

Ferrington (1984) collected an unnamed species of O. *(Euorthocladius)* from Inlet Run, Wyoming, where both *roussellae* and *saxosus* have been collected.

Orthocladius (Euorthocladius) saxosus (Tokunaga)

Figs. 18, 19, 34e, 43, 56–59

Spaniotoma (Orthocladius) saxosa Tokunaga, 1939: 326–329, figs. 16, 39, 61, 77, 97, 109, 117, 125, 134, 146, 153 [description of male, female, pupa, and larva]. Tokunaga, 1959; 1973: 642 [pupa, larva, fide Sasa & Yamamoto, 1977].

Euorthocladius sp. Thienemann, 1941: 180 [record from Lappland].

Euorthocladius saxosus (Tokunaga). Thienemann, 1944: 558, 649 [in pupal, larval keys]. Thienemann, 1954: 301, 303, 345, 511.

Orthocladius (Euorthocladius) saxosus (Tokunaga). Brundin, 1956: 101, fig. 65 [male]. Fittkau et al., 1967: 362 [checklist]. Fittkau & Reiss, 1978: 421 [checklist]. Kownacki & Zosidze, 1980: table 2 [ecology].

Orthocladius saxosus (Tokunaga, 1939). Pankratova, 1970:173, 174, 180, 181, fig. 108 [pupal, larval descriptions; in pupal, larval keys]. Sasa & Yamamoto, 1977:310 [checklist]. Rossaro, 1984: table 2 [record].

Orthocladius (Euorthocladius) sp. Säwedal, 1978:87 [record of Abisko].

Orthocladius (Euorthocladius) species 5 Coffman & Ferrington, 1984: figs. 25.412–25.414 [pupa].

?Orthocladius (Euorthocladius) sp. Ferrington 1984: table 7 [drift].

Type Locality: Japan, Kyoto, Kibune.

Type Material: Holotype. Male, Japan, Kyoto, Kibune, Mar 25, 1936, M. Tokunaga (two white labels, one printed). Only the hypopygium and abdominal segments VI–VIII exist, mounted on a slide under one cover slip in Canada balsam by A. R. Soponis. Paratypes (?8). Same data as holotype. Parts of male and female, including genitalia, and exuviae; mounted in Canada balsam under eight coverslips on two slides by A. R. Soponis. Previously mounted, two larvae on two slides and parts of female on two slides.

Diagnosis.

Orthocladius saxosus can be distinguished from other Holarctic species of O. *(Euorthocladius)* by a combination of characters. Adult Male: details of the hypopygium (Figs. 18, 19). Pupa: hooklets along posterior margin of tergite II, with >100 spines, and frontal warts robust. Larva: head capsule dark brown, mentum with 13 teeth, MR<1.5, and AR>1.80.

Derivation of Name: L. *saxum*, rock; L. *osus*, having the nature of, usually indicating abundance. This is probably a reference to the larvae that aggregate on rocks.

Description

Adult Male (n = 2)

Brown to black. Medium species. Head. Verticals 15–19, postorbitals 1. Palps long with 3>4. AR. 1.19–1.20 (OD: 1.3). Thorax. Lateral antepronotals 4–5. Acrostichals absent. Dorsocentrals 8–9. Prealars 3–4. Scutellars 13–19, biserial to multiserial. Wing. Length 2.08–2.20 mm. R with 6 setae. Squamals 18–19. VR 1.00–1.03. Anal lobe not produced. Legs. LR1 0.76 (OD: 0.80). LR2 0.55–0.56. LR3 0.60 (OD: 0.61). Sensilla chaetica on ta1 of p2 (5) and p3 (8–11). Hypopygium (Figs. 18, 19). Virga present, weak to well developed. Superior volsella collar-like. Inferior volsella with dorsal part squared, ventral part prominently extended laterally and ventrally below.

Pupa (Exuviae)

Dark to pale brown. Length 2.5–4.0 mm. Cephalothorax. Frontal warts (Fig. 43) large to small; cephalic tubercles absent. Cephalothoracic setae weak and difficult to see. Precorneals short, about $1^1/_2\times$ as long as dorsocentrals, with light sockets; 1 median antepronotal, 0 lateral antepronotals, 0–4 dorsocentrals, weak; arrangement of dorsocentrals varies. Thoracic horn (Fig. 34 e) ellipsoid, dark to light brown, filled, stalked; length 50–100 μm. Thorax dorsally granulose anteriorly and along eclosion line.

Abdomen (Fig. 44). Tergites: I, II bare. II–V with central patch of recurved hooklets along posterior margin; patch on II almost 2× as large as other patches; VI, VII with patch of straight spines along posterior margin; III–VIII with patch of spinules anteriorly. Sternites: I, VIII bare; II–VI with central horizontal patch of spinules anteriorly; VI with spinules along posterior margin; VI, VII with 2 off-center patches of spinules anteriorly.

Setae on segments I–VIII:

	I	II	III	IV	V	VI	VII	VIII
D	4	5	5	5	5	5	5	1
L	1	2	3	3	3	3	4	3
V	0	2	2	3	3	3	2	1
Od	0	1	1	1	1	1	1	1

Anal lobe greatly reduced, setae absent. Genital sheaths extended beyond lobe in male and female. Pedes spurii B on I, II, III, and sometimes IV; pedes spurii A on VI, VII.

Variation. The size and color of the thoracic horn, and the size and shape of frontal warts vary. Setal counts here do not agree with the original diagnosis. Hooklets are moveable, but the direction of hooklets on tergites is not diagnostic. The arrangement of the DC is variable, and the number of DC varies from 0–4. The body setae are weak. Small frontal tubercles are found in the type material, and in the material from Wyoming and Sweden. Large frontal tubercles are found in the material from Alberta, Montana, and Alaska (glacial). The dimorphism does not appear to be sexual.

Larva (Fourth Instar)

Body yellowish-brown, reddish-brown, or (OD) greenish-brown. Head capsule dark brown; preserved, yellow. Eye spots fused. Mentum (Figs. 58 c, 59 c) with 13 teeth, median tooth about as wide as 1st lateral; MR 1.2–1.5 (6); median tooth as high as 1st lateral. Ventromental plates extended anteriorly between 2nd and 3rd, 3rd and 4th, or 4th and 5th laterals; less commonly, between 1st and 2nd laterals. Epipharynx (Fig. 56) with premandible simple, blunt, with enlarged apex. Chaetula laterales sparse. Mandible (Figs. 58 a, 59 a) with apical tooth as long or longer than 1st inner tooth; outer margin notched opposite seta subdentalis; rest of margin smooth except for occasional notch posteriorly. Seta interna present. Antenna (Figs. 58 b, 59 b) with robust Lauterborn organs; blade extended to 5th segment or beyond. AR 1.80–2.22 (6). Body with setal arrangement in 4 different patterns (Fig. 57): those on I, II, III and IV–X. Anal tubules moderately long, rounded, with dorsal pair shorter and thicker than ventral pair.

Variation. The apical tooth of the mandible is variable, appearing more reduced in Nearctic than in type material, but this may be due to orientation. Also, the mandible has 5 true teeth in the type material and in the Montana material, but 4 true teeth and a false tooth in the Alberta material. The premandible is deeply bifid in a single reared larva from Montana.

Distribution: Palearctic: Italy, Sweden. Japan. Nearctic: Canada (Alberta). USA (Alaska, Colorado, Montana, North Carolina, Oregon, Wyoming).

Material Examined: Type material. Non-type material: Canada. Alberta: Marmot Creek, 29-VI-1977, D. R. Oliver, 7079, 5MP w/LS; 1FP w/LS (CNC). Japan. Mt. Hikosan, Kyushu, III-18-1980, L. T., M. Yamamoto, 2M, 1F (YAM). Sweden. Lappland 1936, 41, orig. Thienemann material, 4Ex (ZSM). USA. Alaska: Portage glacial pool, 20-VII-1977, #19, D. Wartinbee, 2Ex (COFF). Colorado: Gunnison Co., Beaver Dam on East R., 3.1 mi. N of Gothic, 13 July 1982, L. Ferrington, No.Co. #9, 6Ex, 1P (SBSK). Montana: Beartooth-Absaroka Wilderness area, 31-VII-1979, E. R. Wells, CH6965.1, 1 MP w/LS (CNC). Glacier Nat'l Park, small stream in west meadow w of Logan Pass (Continental Divide), 11-VIII-1975, R. W. Lichwardt, MBL-13, 27a, 1Ex, 1FP w/LS, 14a, 1FP w/LS (ANSP). North Carolina. Richmond Co., Forest Creek, 24-I-1981, D. Lenat, 1L; Wake Co., Cane Creek, 9-II-1980, D. Lenat and S. Mozley, 1L; Wake Co., Reedy Creek at US 40, 28-XII-1979, D. Lenat and K. Eagleson, 2L (NCDNR). Oregon: Deschutes Co., Century Drive, Goose Creek, Headwater Springs, 20-VIII-1983, B. Wisseman, gelatinous sheat, wood, 4L; Lane Co., H. J. Andrews Exp. For., Mack Cr., 11 mi. NE of Blue River, 20-V-1982, 1M; 26-V-1984, 1M; 18-19-II-1977, B. B. Frost, drift sample, 6pm–9am, clearcut, 1Ex (OSU). Wyoming: Trib. to Beartooth Lake, 19-VIII-1974, S1.2, W. P. Coffman, 4Ex (COFF); Park Co., "Inlet Run"-Frozen Lake nr. Beartooth Pass, 5-VIII-1978, L. Ferrington, 20Ex (SBSK).

Biology: Larvae live in clear, irregular gelatinous tubes 10–16 mm long and 3–5 mm wide, closely adhering to stones along small crevices in rapid mountain streams. Pupal tubes are more oval, 7–10 mm long and 4–6 mm wide, with 3 mm long stems. Larvae are common in winter (Tokunaga 1939). This species occurs with *suspensus*. Mites have been associated with *saxosus* (Thienemann 1954). Ferrington (1984) collected an unnamed species of *O. (Euorthocladius)* from Inlet Run, Wyoming, where both *saxosus* and *roussellae* have been collected.

Remarks: Tokunaga (1939) described this species from an unspecified number of males, females, pupae, and larvae collected in a rapid stream at Kibune, Kyoto, Japan. Type material of all stages still exists.

Thienemann (1944) recognized *saxosus* as belonging to his genus *Euorthocladius* and included the pupae and larvae in his keys. He separated the pupae primarily by the patches of hooklets on tergites II–V, and the larva by the anal tubules and labrum. He also recognized that his pupal skins in the 1941 Lappland work belonged to this species.

Brundin (1956) placed *saxosus* in the subgenus *Orthocladius (Euorthocladius)* and provided the first complete illustration of the hypoygium. Pankratova (1970) provided a description of the pupa and larva with figures reproduced from Tokunaga (1939). In the pupal keys she did not separate *saxosus* from *thienemanni* and *rivicola*, but did so in the larval keys using the dorsal pair of anal gills which are shorter than the ventral pair.

Pankratova (1970) mentioned that the larval premandible is bifurcate, seen only in one examined specimen from Montana.

This species has been included in several checklists (Fittkau et al., 1967, Fittkau & Reiss 1978, Sasa & Yamamoto, 1977), probably because it could be easily identified. The male and pupa of *saxosus* are very distinctive. In addition, Brundin's (1956) illustration of the hypopygium and Thienemann's (1944) pupal key have contributed to the relative ease of identification of the species.

Coffman & Ferrington (1984) included the pupa in their keys; *saxosus* keys to couplet 55.

Orthocladius (Euorthocladius) suspensus (Tokunaga)

Fig. 17

Spaniotoma (Orthocladius) suspensa Tokunaga, 1939: 323–326, figs. 15, 38, 63, 64, 70, 80, 85, 100, 118, 122, 135, 145, 151 [description of male, female, pupa, and larva]. Tokunaga, 1959; 1973: 642 [pupa, larva, fide Sasa & Yamamoto, 1977].

Euorthocladius suspensus (Tokunaga), Thienemann, 1944: 558, 649 [in pupal, larval key]. Thienemann, 1954: 345 [note].

Orthocladius (sen.str.) *suspensus* (Tokunaga). Tokunaga, 1964: 17, fig. 2 [notes on adult].

Orthocladius suspensus (Tokunaga, 1939). Sasa & Yamamoto, 1977: 310 [checklist].

[non] *Orthocladius suspensus* (Tokunaga, 1939) sensu Ree & Kim, 1981: 176, 177, plate 27 [misidentification].

Type Locality: Japan, Kyoto, Kibune.

Type Material: Holotype. Male, mounted on a slide under 5 coverslips in Canada balsam by A. R. Soponis. Japan, Kyoto, Kibune, Mar. 25, 1936, M. Tokunaga (typed label). Preserved in Kyushu University.

Diagnosis

Orthocladius suspensus can be distinguished from other Holarctic species of *O. (Euorthocladius)* by a combination of characters. Adult Male: low AR (<1.8) and details of the hypopygium (Fig. 17). Pupa: hooklets along posterior margin of tergite II, small patches of spines on tergites III–VIII, smooth thorcic horn, absence of spine rows on posterior margins of tergites IV–VI. Larva: mentum with about 19 teeth; distinguishable from *rivulorum* by distribution.

Derivation of Name: L. suspendere, to hang up. This is probably a reference to the larval tube, which is suspended from stones by one end.

Description: (See also Tokunaga 1939)

Adult Male (n = 1, holotype)

Brown (OD: black). Large species. Head. Verticals 12. postorbitals 0. Palps long with 3<4. AR 1.68 (OD: 1.5–1.7). Thorax. Lateral antepronotals 3. Acrostichals absent, but sockets may be present. Dorsocentrals 10. Prealars 4. Scutellars 23, multiserial. Wing. Length 3.28 mm. R with 6 setae. Squamals 34. VR 1.08. Anal lobe not produced, almost right-angled. Legs. (OD: LR1 0.69. LR3 0.57). Sensilla chaetica could not be determined. Hypopygium (Fig. 17). Virga absent or vestige present. Superior volsella collar-like. Inferior volsella with dorsal part nose-like, covering most of ventral part. Crista dorsalis long.

Biology: The larvae occur in mountain streams in Japan. They live in cylindrical tubes, 20–37 mm long, 2.6–3.5 mm wide, coated with a thick growth of diatoms that makes the tubes look green. Pupal tubes are smiliar in size to larval tubes, with an oval chamber at the free and. The oval chamber is pointed at the distal end, with one respiratory opening at either end of the chamber, 7 mm long and 3.2 mm wide (Tokunaga, 1939). Both Taylor (1903) and Lauterborn (1905) have described tubes of *rivulorum* smilarly. This species occurs with *saxosus*.

Distribution: Japan.

Material Examined: Holotype.

Remarks: Tokunaga (1939) described this species from an unspecified number of males, females, pupae, and larvae collected in a mountain steam at Kibune, Kyoto, Japan. Only the holotype, a complete male, was located among the original type material at Kyushu University (Dr. Y. Hirashima, pers. comm.).

It has not been easy to identify *suspensus* in the adult male. Tokunaga (1939, fig. 38) illustrated only part of the hypopygium. Later, Tokunaga (1964, fig. 2) illustrated a hypopygium that was dorsoventrally compressed with the ventral part of the inferior volsella pushed below the dorsal part. He had placed *suspensus* in *Orthocladius* (s.s.) without comment, probably influenced by the distorted inferior volsella. In addition, these specimens had an AR of 3.00, a record for the species and for the genus *Orthocladius*. This may prove to be a misidentification, but because the figured specimen was distorted, and only the holotype has been examined, it is difficult to decide.

Ree & Kim (1981), most likely following Tokunaga's (1964) work, described as *suspensus* the male and female of a species of *Orthocladius (Orthocladius)*. This species belongs to the subgenus *Orthocladius* because of the uniserial scutellars, presence of acrostichals, pointed anal point, and double-lobed inferior volsella.

The immature stages of *suspensus* are morphologically similar to those of *rivulorum*, and the larvae of both species live in similar tubes. The adult male of *suspensus* has a distinctly different hypopygium (Fig. 17) from that of *rivulorum* (Figs. 20, 21), particularly in regard to the inferior volsella. Tokunaga (1939) provided characters to separate the pupae of *rivulorum* from *suspensus*, and so did Thienemann (1944), based on Potthast's (1914) description of *rivulorum*. Characters used in the keys are based on the original description.

Thienemann (1954) briefly commented on the similarity of *suspensus* and *rivulorum*.

Orthocladius (Euorthocladius) telochaetus Langton
Fig. 16

Orthocladius (Euorthocladius) telochaetus Langton, 1985: [description of male].

Type Locality: Spitzbergen: Advent Bay.

Type Material: Holotype. Male, Spitzbergen, Advent Bay, Holmgren (two white labels), 116 79 (pink label), Riksmuseum Stockholm (green label), "These 2 ♂ apparently = *decoratus*-F. W. E." (tan label), "*Ch. limbatellus* Holmgren 1869 ♂ PARALECTOTYPE *Orthocladius (Euorth.) telochaetus* n. sp. Langton P. H. 1985 HOLOTYPE" (white label). Paratype. Male, similar green and white labels with 115 79 on pink label.

Diagnosis

The male of *Orthocladius telochaetus* can be distinguished from other males of *O. (Euorthocladius)* by details of the hypopygium (Fig. 16), primarily the apical seta on the anal point. The pupa and larva are unknown.

Derivation of Name: Gr. *telos*, end; *chaite*, seta. Langton named this species for the apical seta on the anal point of the hypopgyium.

Description: See Langton (1985). Additional characters include: head female-like; VR 1.09; acrostichals absent; >5 dorsocentrals, uniserial; 3 prealars; anal point with microtrichia.
Biology: Unknown.
Distribution: Palearctic: Spitzbergen.

Material Examined: Type material. Non-type material: Spitzbergen: Gipsdalen, 17-VII-1954, Tage Roos, CH3659, 1M (CNC).

Remarks: Langton (1985) described this species from two males in the mixed type series of *Chironomus limbatellus* Holmgren. One aspect of the hypopygium makes this species unique in *Orthocladius*: a single apical seta on the anal point. Microtrichia on the anal point, while rare, occur in other *O. (Euorthocladius)* from high latitudes.

The male of *telochaetus* is morphologically similar to *saxosus*, as Langton (1985) pointed out. These two species can be distinguished by these characters of *telochaetus*: the more numerous squamals (27–31, 3; *saxosus* 13–19, 2); absence of sensilla chaetica on ta1 of p3, lower LR's, and more robust virga. Both species occur at high latitudes, although *saxosus* is found in low arctic (Lappland) and *telochaetus* is found in high arctic (Spitzbergen).

Orthocladius (Euorthocladius) thienemanni Kieffer
Figs. 25b, 27, 28, 34f, 37d, 40, 42, 52

Orthocladius thienemanni Kieffer. Kieffer & Thienemann, 1906: 143, 144, 146–149, figs. 1–5 [description of adult, pupa, larva]. Kieffer & Thienemann, 1909: 32 [ecology]. Potthast 1914: 263, figs. 1–5 [pupa, larva]. Thienemann, 1935: 203–205, fig. 2[synonymy, in pupal, larval keys, notes, distribution]. Pankratova, 1970: 173, 174, 177, 178, fig. 105 [pupal, larval descriptions; in pupal, larval keys]. Illies, 1971: 46, table 5 [ecology]. Drake, 1982: 231, 234, 240, fig. 6 [ecology]. Reiss, 1983: 176 [checklist]. Rossaro, 1984: table 2 [record]. Bitušík & Ertlová, 1985: 604, 606, table 2 [ecology].

Orthocladius (Orthocladius) thienemanni Kieffer. Goetghebuer, 1932: 75, 89, fig. 144 [adult description, in adult key]. Goetghebuer, 1942: 34, 36, 55, fig. 95 [male, female descriptions; in male, female keys].

Spantiotoma (Orthocladius) thienemanni Kieffer. Johannsen, 1937: 56, 60, 62, 72 [in pupal, larval keys; notes].

Euorthocladius thienemanni Kieffer. Thienemann, 1944: 559, 648, fig. 12 [in pupal, larval keys]. Romaniszyn, 1958: 27, 82, fig. 122, 126, 127 [in larval key]. Thienemann, 1954: 146, 182, 345, 349, 356, 360, 364, fig. 102 [notes].

Hydrobaenus (Bryophaenocladius) thienemanni (Kieffer). Kloet & Hincks, 1945: 337 [checklist].

Hydrobaenus thienemanni (Kieffer). Roback, 1957a: 76 [in pupal, larval keys].

Orthocladius ex gp. *thienemanni* Kieffer. Chernovskii, 1949: 205, 282, fig. 129b [synonymy, in larval key].

Orthocladius (Euorthocladius) thienemanni Kieffer. Brundin, 1956: 95, 96, 101, fig. 63 [notes, distribution]. Fittkau et al., 1967: 362 [checklist]. Lehmann, 1971: 486 [ecology]. Kloet & Hincks, 1975: (V)15 [checklist]. Rossaro, 1977: 122 [distribution]. Rossaro, 1978a: 290 [distribution]. Rossaro, 1978b: 185 [distribution]. Fittkau & Reiss, 1978: 421 [checklist]. Pinder, 1978: 70, fig. 35E, 111C [in key to males]. Cranston, 1982: 102, figs. 39a, c, f [in

larval key]. Moubayed & Laville, 1983: 223 [distribution]. Murray & Ashe, 1983: 230 [checklist]. Langton, 1984: 144, fig. 49d [in pupal key]. Sahin, 1984: 82, figs. 200–202 [in larval key]. Michailova, 1985: 149, 158, 159, 163, 164, pl. v, viii [cytology].

Orthocladius (Euorthocladius) cf. *thienemanni-saxosus* [partim]. Coffman, 1973: table 1 [ecology].

Orthocladius (Euorthocladius) species 6 [partim]. Coffman & Ferrington, 1984: fig. 25.415 [pupa].

[non] *Spaniotoma (Orthocladius) thienemanni* Kieffer sensu Edwards, 1929: 344, 345, fig. 6m [partim] [in key to males] [misident.].

[non] *Orthocladius (Euorthocladius)* cf. *thienemanni* (Kieffer). Halvorsen et al., 1982:119 [record].

Type Locality: Germany: Insel Rügen: Thuringen (see Cranston 1984).

Type Material: Lectotype. Male, original label hand-written, *Orthocladius thienemanni* K.; printed label, R. I. Sc. N. B. 18.073, coll et det M. Goetghebuer; typed label. Boîtes no 6 Types Kieffer. Previously mounted in balsam under two coverslips on a slide; overcleared. Abdomen III–IX dissected from body; hypopygium intact. Wings crumpled and folded over; head squashed; only antennal flagellomeres 1 and 2 present; parts of legs missing. Hereby designated as lectotype.

Presumably original labels have been replaced, and other labels added to the lectotype in routine curation, because "coll et det M. Goetghebuer" makes no sense in a species reared by Thienemann and described by Kieffer. Presently there appear to be no other sepcimens that unquestionably belong to the original type series.

Diagnosis

Orthocladius thienemanni can be distinguished from other Holarctic species of O. *(Euorthocladius)* by a combination of characters. Adult Male: high AR (>1.75), relative lengths of palpal segments ($3 \doteq 4$), and details of the hypopygium (Figs. 27, 28). Pupa: rows of spines on anal margins of tergites III–VIII; thoracic horn present; absence of hooklets on II and absence of pedes spurii A. Larva: 13 teeth on the mentum, wide median tooth (MR>1.5), and high AR (>1.8).

Derivation of Name: Kieffer named this species after A. Thienemann.

Description

Adult Male (n = 5)

Dark brown. Large species. Head. Verticals 10–23, postorbitals 1–3 (4). Palps long with $3 \lesssim 4$ (4) (Type: 3=4). AR 1.75–2.15 (2). Thorax. Lateral antepronotals 2–7 (4). Acrostichals absent. Dorsocentrals 4–16. Prealars 3–7. Scutellars 15–26, biserial to multiserial (Type: 22, multiserial). Wing. Length 2.80–3.18 mm (4). R with 4–10 (3) setae. Squamals 30–40 (4). VR 1.06–1.14 (4). Anal lobe moderately produced (OD: right-angled). Legs. LR1 0.68–0.74 (3). LR2 0.45–0.53 (4). LR3 0.53–0.56 (4). Sensilla chaetica on ta1 of p2 (7–13) (4), absent on p3. Hypopygium (Figs. 27, 28). Virga present. Superior volsella collar-like. Inferior volsella with dorsal part slender, inner margin rounded, apex rounded or squared, and ventral part covered or extended below. Crista dorsalis long, robust.

Variation. Only six specimens, two originally collected and identified by Thienemann, have been examined. Lehmann (1971) reported the AR of *thienemanni* as 1.80–2.00 from his Fulda material.

Pupa (Exuviae)

Light brown, with darker apophyses on I–VIII, variable. Length 3.15–4.29 mm (10). Cephalothorax. Frontal warts weak to moderately developed; cephalic tubercles absent. Precorneals clumped, weak to strong, $1^1/_4\times$ as long as dorsocentrals; 2 median antepronotals, 1 lateral antepronotals, 3 dorsocentrals in a row, thicker than precorneals. Thoracic horn (Fig. 34f) ellipsoid, light brown, filled or clear, stalked; length 30–70 μm (10). Thorax dorsally wrinkled to granulose anteriorly along eclosion line.

Abdomen (Fig. 42). Tergites: I bare; III–VIII with 2–4 rows of strong spines along posterior margin (Fig. 37d); II–VIII with central patch of spinules anteriorly. Sternites: I, VIII bare; II–VII with 2 off-center patches of spinules anteriorly.

Setae on segments I–VIII:

D	4	5	5	5	5	5	5	1	L	1	3	3	3	3	3	3	4
V	1	3	3	3	3	3	3	0	Od	0	0	0	0	0	0	0	0

Anal lobe greatly reduced, one seta at midpoint. Genital sheaths extended beyond lobe in male and female. Pedes spurii A and B absent.

Variation. Associated exuviae from the Fulda (collected by Lehmann) and from Bathurst Island, NWT, as well as pupae from Kansas were examined here. The European material is more robust than the North American material. Anterior shagreen may be absent on tergite II.

Larva (Fourth Instar) (n = 11)

Body yellow, brown, or green. Head capsule brown; preserved, yellow. Eye spots fused. Mentum (Fig.52c) with 13 teeth, median tooth about 2× as wide as 1st lateral; MR 1.5–2.3; median tooth higher than 1st lateral. Ventromental plates extended anteriorly between 2nd and 3rd laterals. Premandible simple. Chaetula laterales sparse. Mandible (Fig.52a) with apical tooth as long or longer than first inner tooth; outer margin notched opposite seta subdentalis, rest of margin smooth except for occasional notch posteriorly; seta interna present. Antenna (Fig.52b) with robust Lauterborn organs; blade extended to 4th segment. AR 1.85–2.56. Body with simple, long setae, most likely arranged like that in *saxosus* (Fig. 57). Anal tubules subequal, moderately long, all same length and thickness, weakly pointed (Thienemann 1944: rounded).

Variation. Cranston (1982) recorded the head capsule as yellow-brown, and figured the mandible without the margin notched opposite the seta subdentalis. In one specimen excamined here, the premandible appears notched.

Material from Sabina Creek, Arizona, shows considerable variation in the width of the median tooth. With a lower MR, theese larvae will key to *saxosus*. The larvae of both of these species occur gregariously on stones.

Thienemann (Kieffer & Thienemann 1906) described the larva as green. In the material examined here, all preserved on slides, the body is either yellow, green, or brown.

Biology: Larvae live on the surfaces of larger stones in fast-flowing brooks, streams, and rivers (Kieffer & Thienemann 1906, Thienemann 1935, 1944, 1954, Lehmann 1971). Larvae live in clear gelatinous tubes encrusted with sand grains, often in fissures and depressions of the stone. Larvae are also associated with algal growth on stones (Thienemann 1954) and with the common bulrush, *Schoenoplectus lacustris* (Drake 1982). In a chalk stream of southern England, Drake (1982) found that *thienemanni* was the most abundant species of larval chironomid in the cold months. In his study, larvae were present during high discharge, but absent in low flow.

Pupae live in the enlarged larval tubes: half-ellipsoid, 6 mm long, 3 mm wide, 2 mm high, clear gelatinous tubes covered with small particles. The pupa undulates, causing water to flow through openings at both ends of the tube, as figured here (Fig.40) and in Thienemann (1954, fig.102) after Miall and Hammond (1900, fig.5). The pupal stage lasts 3–7 days (Kieffer & Thienemann 1906, Thienemann 1954).

Gregarious pupation of *thienemanni* in a spring-fed tributary of Sabina Creek near Pigeon Springs, Arizona, was observed by Jan Doughman (pers. comm.). In February, 1984, water temperature was 4°C with ice on the surface. Larvae were feeding on a thin film of diatoms on rocks. Larvae congregated in small (0.5 cm diam) vertical depressions on a 1' × 1' granite rock, then stopped feeding, and spun a gelatinous sheath over themselves (up to eight larvae under one sheath). Mature pupae alone, or pupae with mature larvae were found under some sheaths.

This species occurs with *rivicola* (based on exuviae) in seven localities (see *rivicola);* and with *calvus* (based on adults) in Germany.

Adults swarm in large numbers (Thienemann & Kieffer 1906). Thienemann (1935) reported adults appearing in the first of spring. Illies (1971) recorded emergence of adults from April to August in Breitenbach, Germany. Lehmann (1971) reported two generations in the Fulda: the first from January

to May, the second in October. In southern England, Drake (1982) found two generations in 1976 and 1977, the first emerging January to April, the secound in March and April. In South Carolina, adults emerge from January through April.

Doughman (pers. comm.) has observed that the adults of *thienemanni* hold their wings rooflike over the abdomen.

Distribution: Palearctic: Denmark, England, Germany, Ireland, Lebanon, Switzerland, and Turkey. Nearctic: Canada, Greenland, USA.

Material Examined: Lectotype. Non-type material: No locality: coll. et det. M. Goetghebuer, R.I.Sc.N.B. 18.073, 1M (BRUX). Canada. Northwest Territories: Oscar Creek, 25-V-1972, FWI-Pipeline Project, CH6475, 2P. Ontario: Ottawa, Ottawa River, 22-IV-1966, Jon Martin, 0122-1, 2PEx (CNC); Rushing River, 9-V-1978, W.P. Coffmann, 2PEx (COFF). Denmark. Zealand, Lellinge Å, 20-V-1968, C. Lindegaard, 3Ex, 2L (? COP). England. East Sussex, nr. Forest Row, 51414347, 17-IV-1978, P. S. Cranston, BM1978-197, 1L (BMNH); Bucks, River Chess, 16-II-1982, W. R. Karsteter, 1L (FSCA). Germany. River Schwentine, East Holstein, 1935, A. Thienemann, 1M; Insel Rügen, A. Thienemann, 1M, 2P, Baumberge, bei Münster, Westfalen, 2-II-1908, Thienemann, 1M; Fulda, Hessen 10-I-1969, Nr. 27b, J. Lehmann, 1M w/ PEx; Fulda, Br. Sandlofs, 17-X-1952, E. J. Fittkau, 12 PEx (ZSM). Greenland. Tilloe Narssag Elv. hole 740, 24-VIII-1981, C. Lindegaard, 3PEx; 9DR, 11-12-VII-1981, M w/Ex (? COP). Switzerland. Stein am Rhein, 20-III-1966, F. Reiss, 1M (ZSM). USA. Alaska. N.Fk. Chena R., 11-VII-1978, D. Wartinbee, 1Ex (COFF); Jim River above Prospect Camp, left bank, 095073, USGS, 1Ex (CALD). Arizona. coll J. Doughman: Pima Co., Sabino Creek at Summerhaven (0.6 mi up forest rd.) on Mt. Lemmon nr. Tucson, from rocks, 5-II-1984, 840205, 1FP, 1MP, 10L; 26-II-1984, 840226, 1MP, 1FP, 1L; Pinal Co., Boyce-Thompson Arb., Queen Cr., Cladophora zone, 840201, 1FP, 4L (USGS). Georgia. Fannin Co., Noontootla Creek at Newport Rd., 24-IV-1979, 1L, 1FP (CALD). Kansas. Johnson Cop., Cedar Creek, 29-XII-1977, P.L., 4FP,4MP; Douglas Co., Deer Creek, 0.5 mi S of Stull, 20-III-1981, L. Ferrington, 13PEx; Atchinson Co., stream 5.5mi S, 0.2 mi Atchinson, 24-III-1982, L. Ferrington, 1F w/Ex, 1M w/Ex (SBSK). North Carolina. Yancey Co., Cane R., Sta. 4, XI-1980, K. Dechart, 1L; Macon Co., Calor Fork, 15-I-1981, K. Dechart, 1L; Mitchel Co., N. Toe R., 2-II-1978, K. Dechart, 1L; Iredell Co., Buffalo Shoals Creek, Jan 1981, K. Dechart, 1L; Haywood Co., Pigeon R., May 1980, site #4, 1L, Surry Co., Ararat R., 14-IV-1981, K. Eagleson, 1L; Transylvania Co., French Broad R., nr. Rosman, 25-IV-1978, D. Penrose, 1L (NCNR). Pennsylvania: Linesville Creek, 7-IV-1971, W.P. Coffmann, 1Ex (CNC). South Carolina. Oconee Co., Seneca Cr., Seneca, 22-I-1977, P.L. Hudson, 1Mw/Ex (HUD); 10-II-1977, 1M w/Ex; Oconee Co., East Fk, Chattoga River, Natl Fish Hatchery, 9-III-1978, P.L. Hudson, 1MP (HUD); Oconee Co., Seneca, Flat Shoals River, 9-II-1977, P.L. Hudson, 1M, 2Ex (HUD); Oconee Co., Fall Creek, Lake Keowee, 30-IV-1974, P.L. Hudson, 1Ex (HUD). Tennessee. Pigeon River, Gatlinburg, 3-V-1977, P.L. Hudson, 1 Ex (HUD).

Remarks: In a joint publication (Kieffer & Thienemann 1906), Kieffer named and described this species from the adult male and female. He did not designate a holotype, nor give any information on his material. He did describe general body characters, but gave no figures or details of the genitalia. In the same paper, Thienemann described the pupa and larva of the named species. The description of the immature stages was sufficiently complete to allow the species to be understood, particularly in the pupal stage.

Edwards (1929) included *thienemanni* under his Group C, or *Orthocladius* (s.str.) of his subgenus *Spaniotoma (Orthocladius).* He separated the males of *thienemanni* and *O. glabripennis* by the absence of a fore tarsal beard and an AR of 2.00 in *thienemanni.* His figure 6m was the first available reproduction of the hypopygium. Until recently this figure was interpreted as representing *O. thienemanni.* However, I have examined some of Edwards's material from Herts and Gloucester that he used for his 1929 work. Some of these specimens belong to a recently described species, *O. (Euorthocladius) calvus* Pinder, which can be distinguished from *thienemanni* in adult male essentially by the relative lengths of palpal segments 3 and 4.

Goetghebuer (1932) reproduced Edwards's (1929) figure of *O. thienemanni* and separated it from other *O. (Orthocladius)* by color, AR, LR, and hypopygial details. Later Goetghebuer (1942) essentially reproduced the same figure and description, and included females in his keys to adults.

Brundin (1956) provided a figure of the hypopygium and listed *thienemanni* as type of the subgenus *O. (Orthocladius)* without providing other characters of the species. Pinder (1978) provided the most recent illustration of the hypopygium of *thienemanni,* and included the species in a key to males on the British chironomids.

The immature stages, particularly the pupa, have received more attention in the literature than the adults. Thienemann's larval description (Kieffer & Thienemann 1906) was brief and without drawings. He compared the larva of *thienemanni* to the larva of *O. sordidellus* as described by Johannsen (1905), probably an *Orthocladius (Orthocladius).* It had an AR of 1.66, an MR of 1.5, and the Lauterborn organs were either weak or absent, based on Johannsen's figures. The pupa of *sordidellus* was certainly not *O. (Euorthocladius),* but Thienemann made no mention of this. His pupal description of *thienemanni* was more complete, but Thienemann mistakenly recorded the diagnostic spine rows as present on tergites II-VII, although his figure 2 correctly shows them on tergites III-VIII.

Thienemann (1935) erected the genus *Euorthocladius* with *thienemanni* as type. He gave a synonym for *thienemanni* and its known distribution as Germany, England, and Switzerland. In his larval keys he separated *thienemanni* from *rivicola* by the higher AR (1.85 versus 1.28) and the longer body. In his pupal keys Thienemann separated *thienemanni* from *rivcicola* by the spine rows on III, smaller thoracic horn (see remarks under *rivicola)*, and longer body.

Johannsen (1937) treated *thienemanni* in the group *Euorthocladius* under his subgenus *Spaniotoma (Orthocladius)*. He distinguished the larva of *thienemanni* from the larva of *rivulorum* by the equally long forks of the SI (after Thienemann 1935, figs. 1, 2), and from *obumbratus* by the robust Lauterborn organs and sparser pecten. He distinguished the pupa of *thienemanni* from the pupa of *rivulorum* by the thoracic horns.

In keys, Thienemann (1944) separated the pupa of *thienemanni* from other *Euorthocladius* pupae by the arrangement of spines on the abdominal tergites, the structure of the thoracic horn, and the body length. He separated the larva from other *Euorthocladius* by the length of the anal tubules, AR (1.85), teeth on the mentum, SI, and pecten.

Chernovskii (1949) largely followed Thienemann (1935) and treated the *thienemanni* group in a larval key, distinguished from *rivicola* by higher AR (2.00 versus 1.10) and longer body (8 mm).

Roback (1957a) included *thienemanni* in his keys and separated the larvae (on a subgeneric level) from other *Orthocladius* (as *Hydrobaenus)* by the large Lauterborn organs. He distinguished the pupae by the thoracic horns and the spine patterns of the abdominal tergites.

Pankratova (1970) separated the larvae of *thienemanni* from *rivicola* by the higher AR (2.00 versus 1.40), but did not distinguish the pupa of *thienemanni* from *rivicola* or *saxosus*. She gave a complete description of both larva and pupa, and reproduced figures from Chernovskii (1949), and mentioned that the premandible was bifurcate. A notched premandible was seen in only one specimen here, but this is a difficult character to assess in *O. (Euorthocladius)*. A morphologically similar species, *calvus*, can be distinguished from *thienemanni* by the bifid premandible.

Cranston (1982) separated *thienemanni* from *frigidus* and *rivicola* by the Lauterborn organs and SI of the mandible, and provided figures of the mentum (MR>1.5) and the antenna (AR=1.8).

Romaniszyn (1958) used Potthast's (1914) figures and separated *thienemanni* from *rivicola* by AR and body length. Coffmann & Ferrington (1984) included the pupa in their keys; *thienemanni* will key to couplet 55. Halvorsen et al. (1982) referred to their material of *O. ashei* as cf. *thienemanni*.

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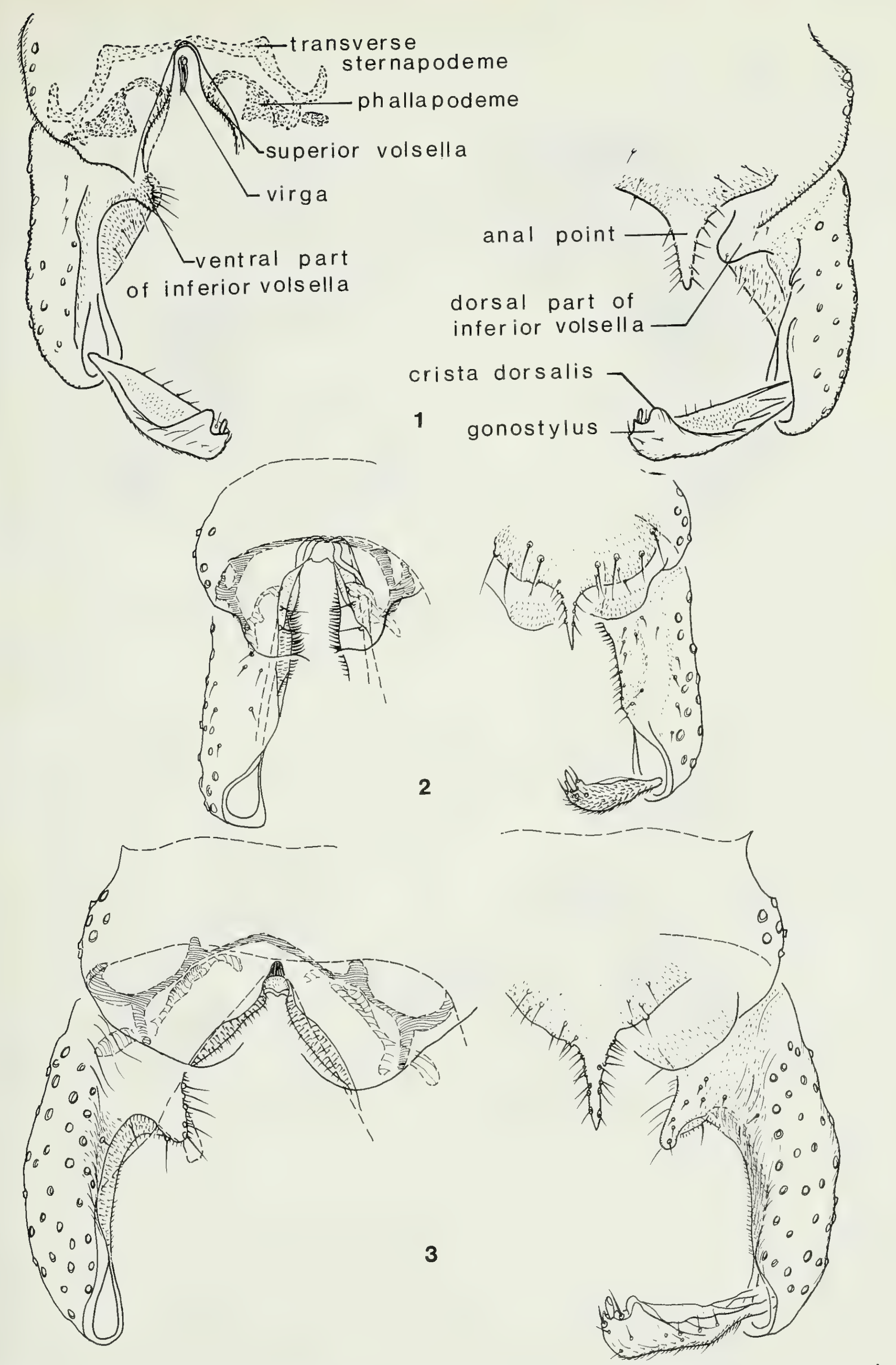


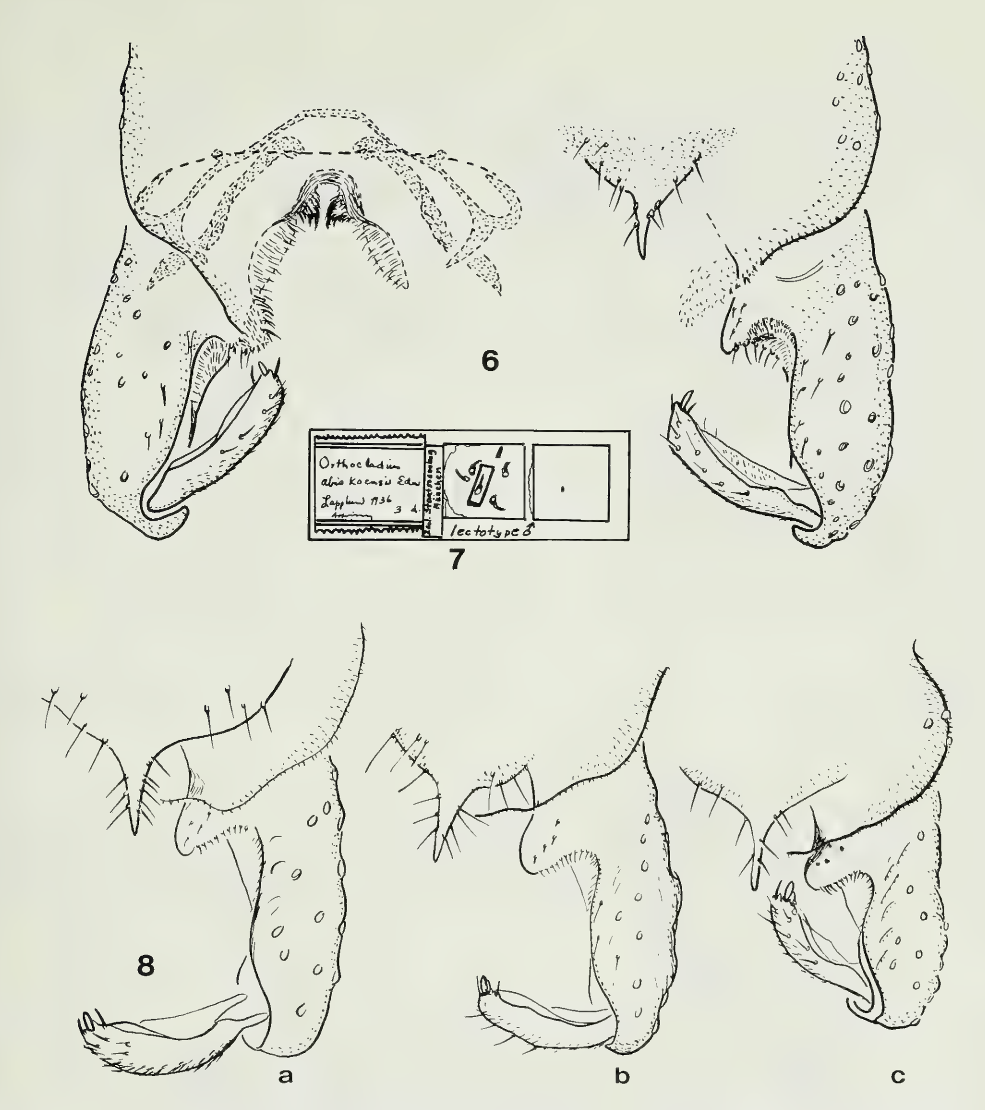
Fig. 1. *Orthocladius (Euorthocladius) luteipes* Goetghebuer, hypopygium, dorsal. Fig. 2. *Orthocladius (Eudactylocladius)* sp., hypopygium, dorsal. Fig. 3. *Orthocladius (Pogonocladius) consobrinus* (Homgren), hypopygium, dorsal.



Fig. 4. *Orthocladius (Orthocladius) trigonolabis* Edwards, hypopygium, dorsal.



Fig. 5. *Orthocladius (Orthocladius) ferringtoni* Soponis, hypopygium, dorsal.



Figs. 6–8. *Orthocladius (Euorthocladius) abiskoensis* Thienemann & Krüger. 6. Hypopygium, dorsal, Edwards type material. 7. Lectotype slide. 8. Hypopygia, dorsal. a. Isachsen, NWT b. Hazen Camp, NWT c. Caribou Bar Creek, NWT.



Fig. 9. *Orthocladius (Euorthocladius) coffmani* n.sp., hypopygium, dorsal, holotype.



Fig. 10. *Orthocladius (Euorthocladius) anteilis* (Roback), hypopygium, dorsal, Idaho.

Figs. 11–15. 11. *Orthocladius (Euorthocladius) roussellae* n.sp., hypopygia, dorsal, partypes. a. Baffin Island, NWT b. Axelheiberg Island, NWT c. Greenland d. Melville Island, NWT. 12. *Orthocladius (Orthocladius) frigidus* (Zetterstedt), head, frontal. 13–15. *Orthocladius (Euorthocladius) roussellae* n.sp. 13. Head, frontal. 14, 15. Hypopygia, dorsal, paratypes, Hazen Camp, NWT.

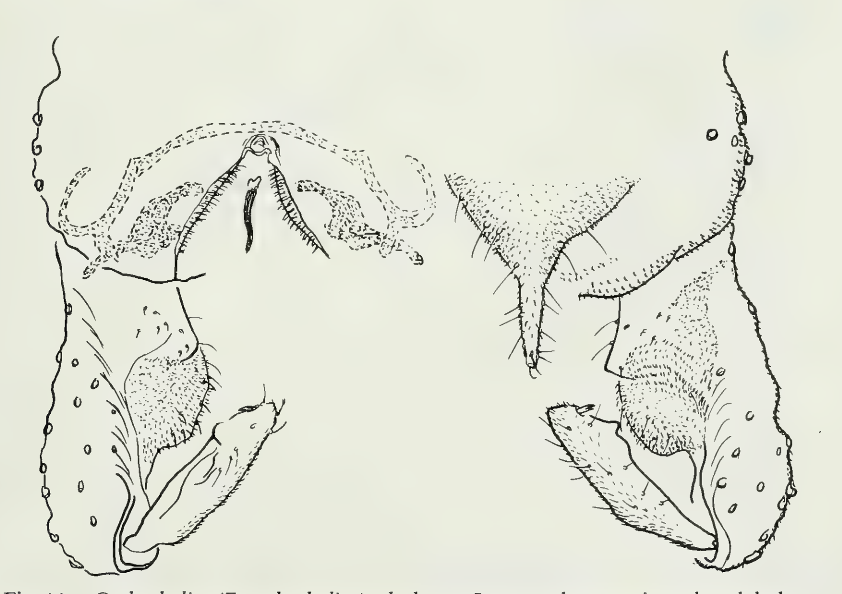


Fig. 16. *Orthocladius (Euorthocladius) telochaetus* Langton, hypopygium, dorsal, holotype.

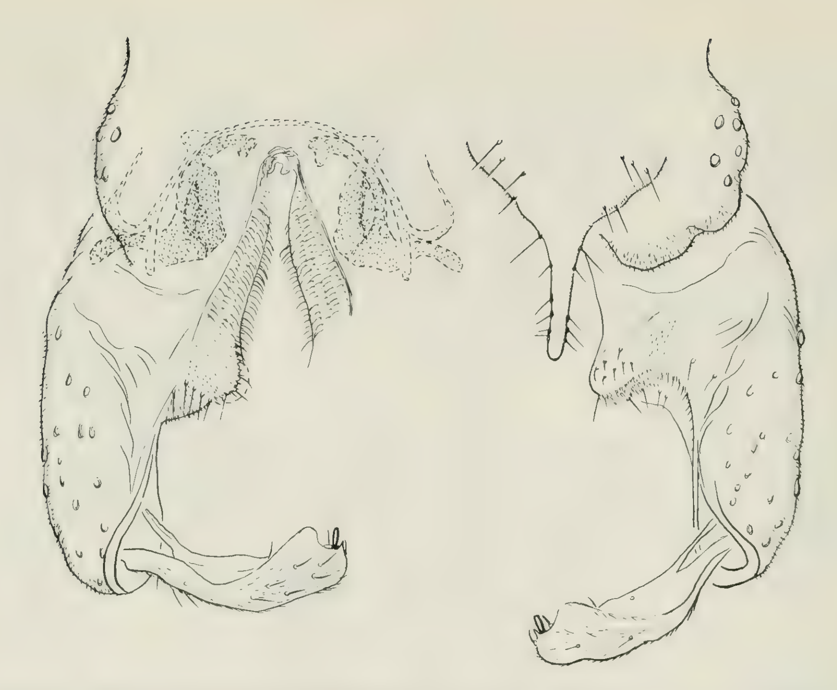
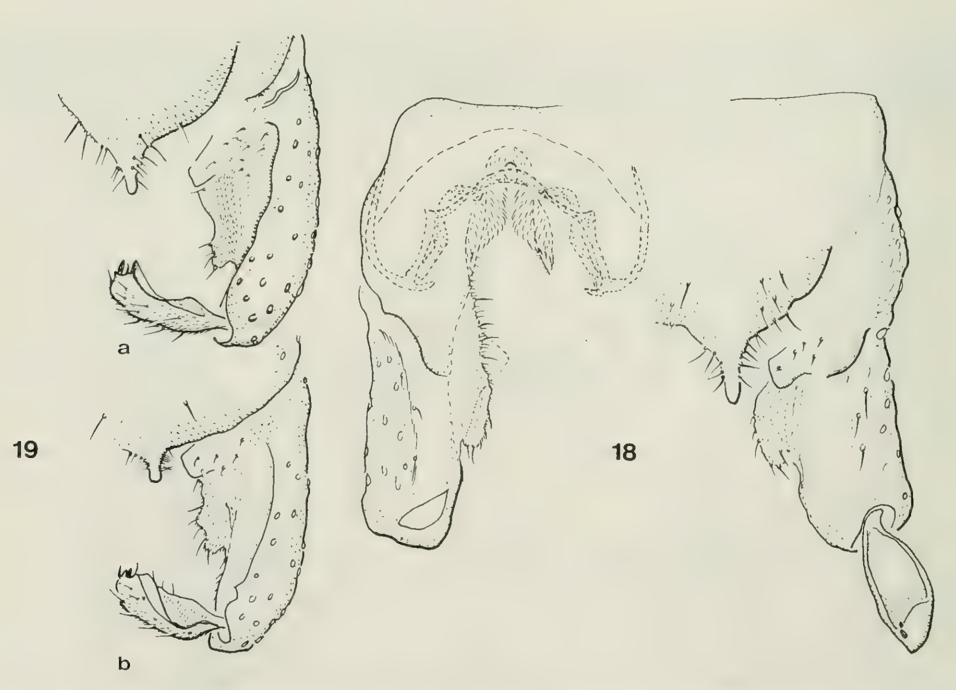
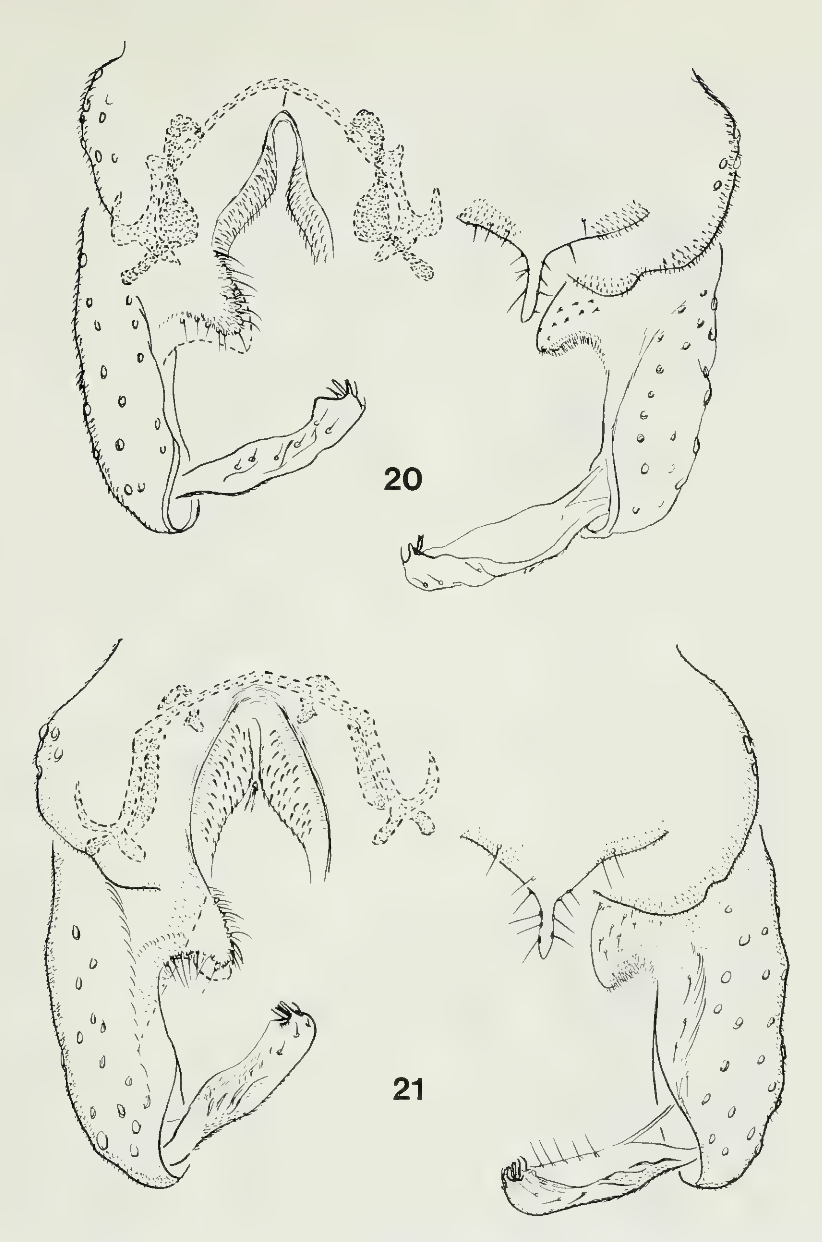


Fig. 17. *Orthocladius (Euorthocladius) suspensus* (Tokunaga), hypopygium, dorsal, holotype.



Figs. 18–19. *Orthocladius (Euorthocladius) saxosus* (Tokunaga), hypopygia, dorsal. 18. holotype. 19. a, b. Japan, non-type material.



Figs. 20–21. *Orthocladius (Euorthocladius) rivulorum* Kieffer, hypopygia, dorsal. 20. Ireland. 21. England.

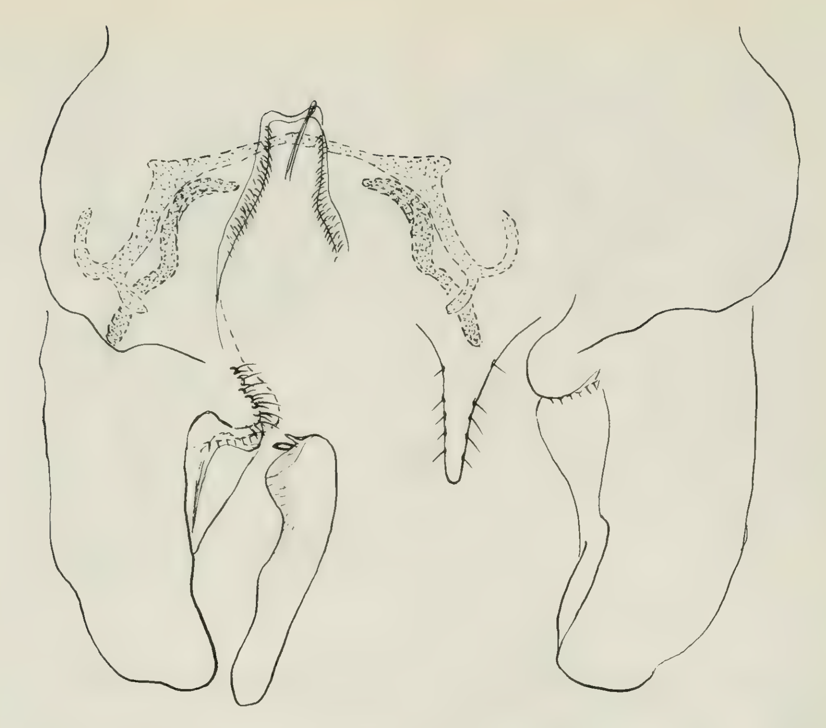


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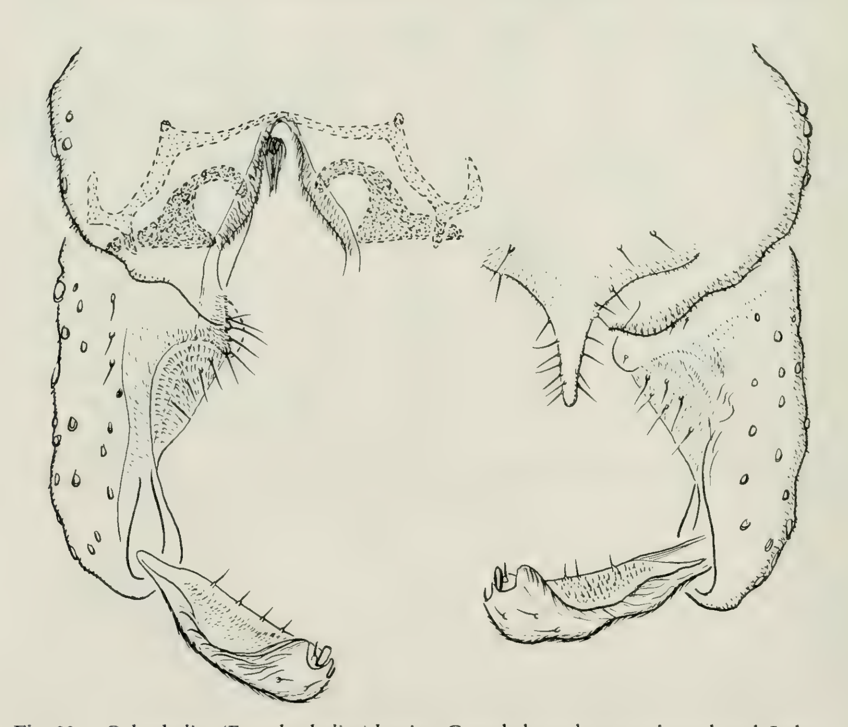
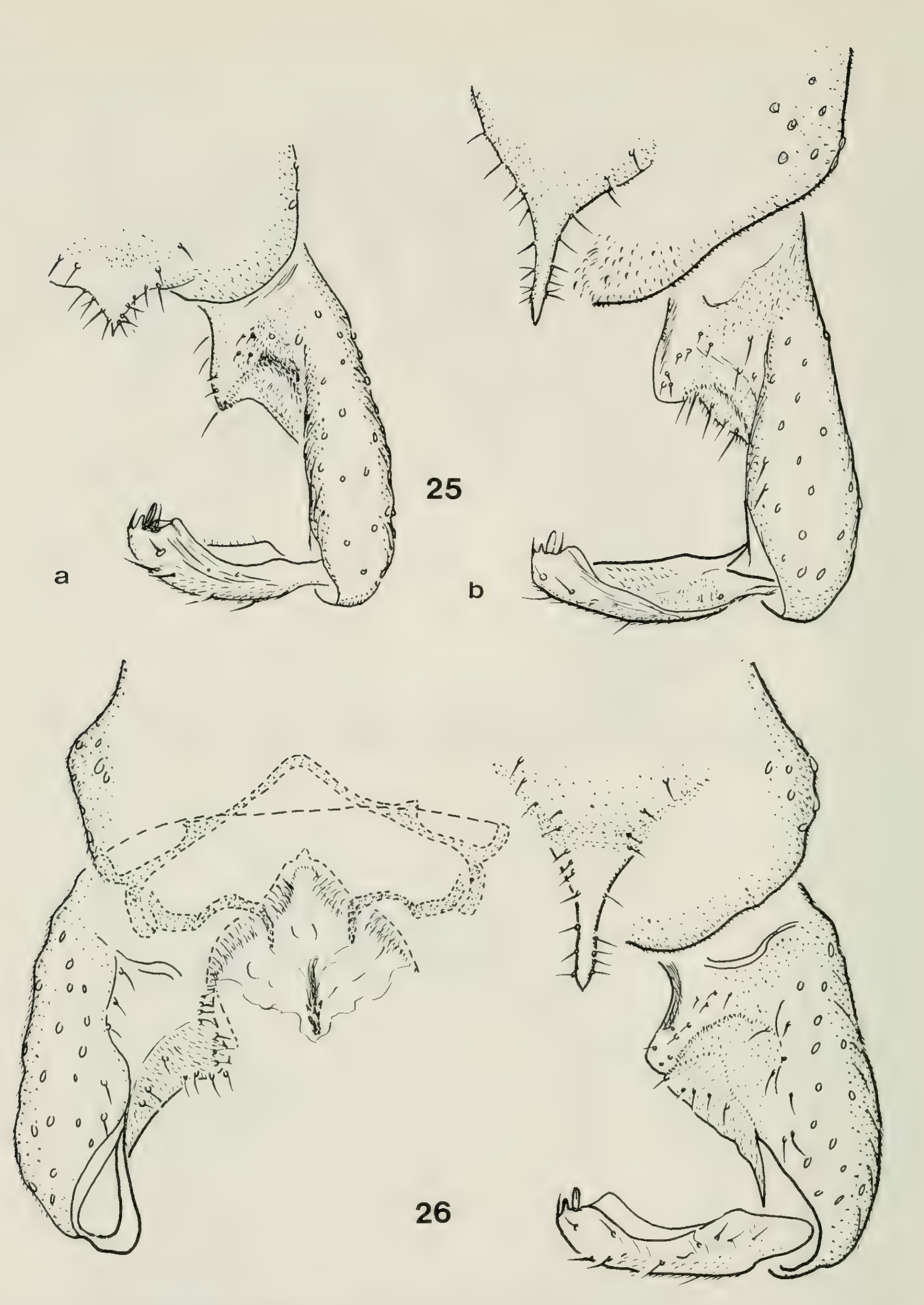


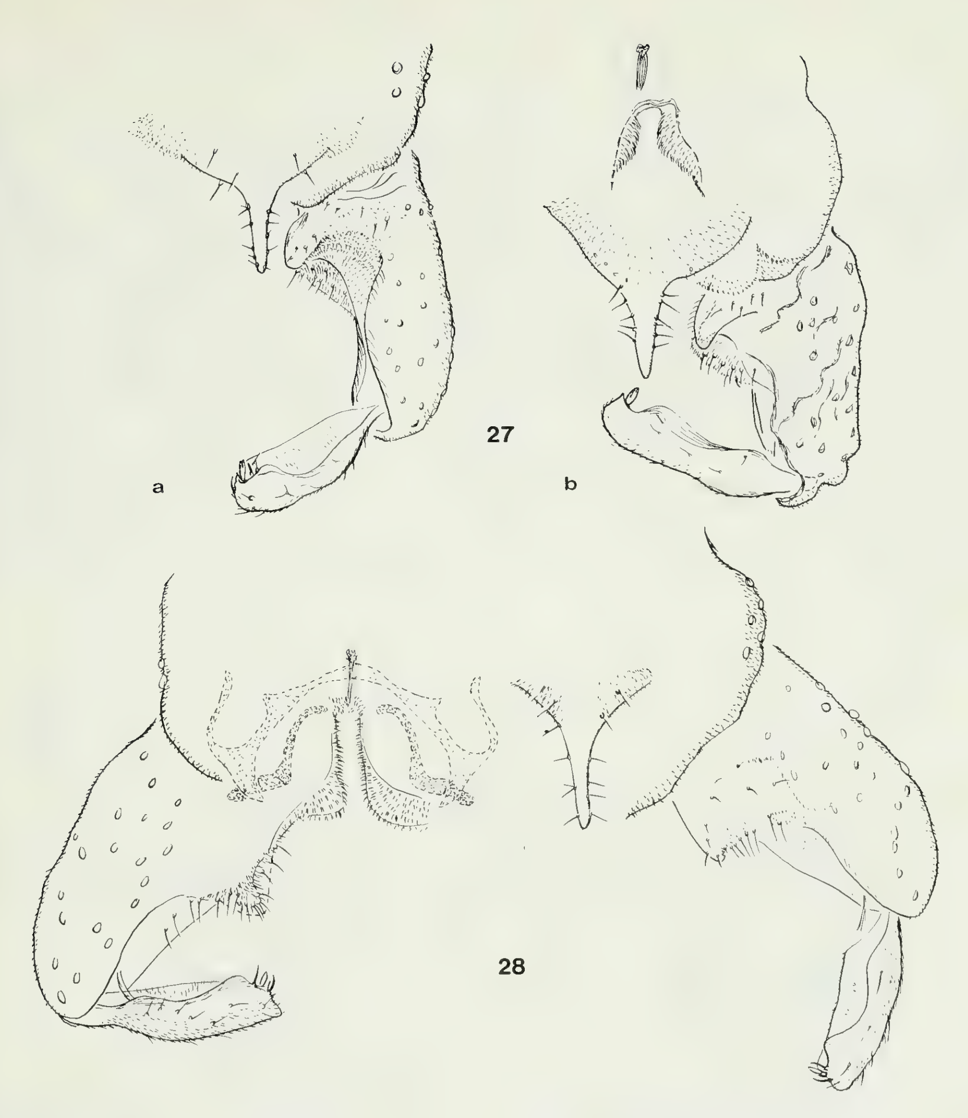
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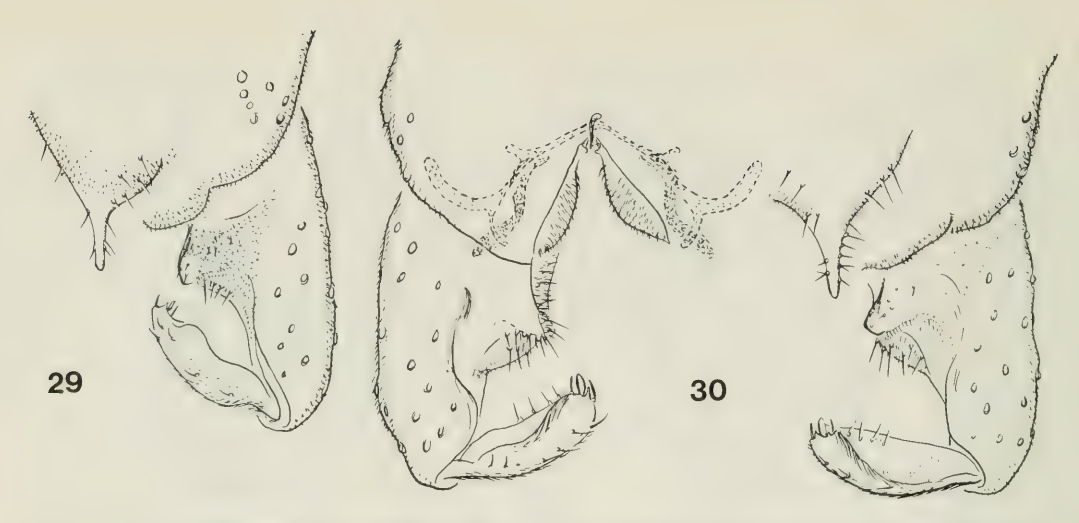
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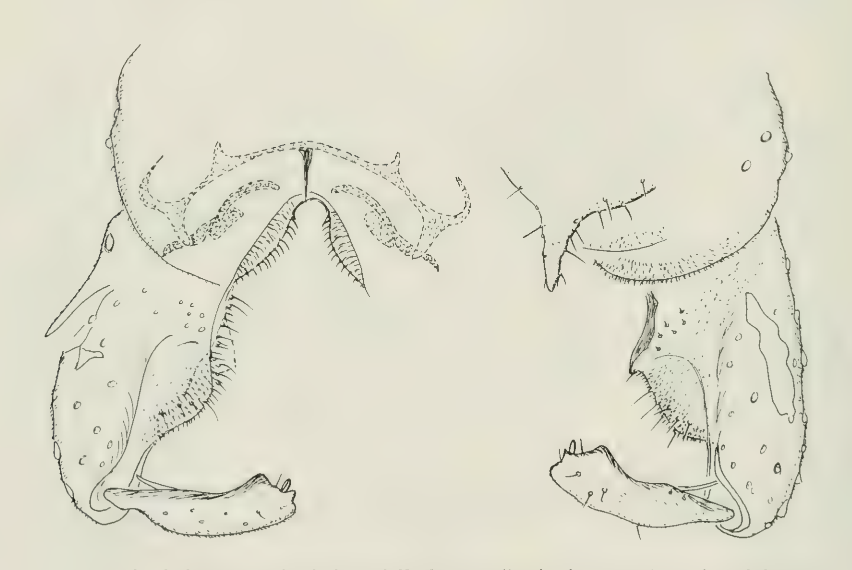
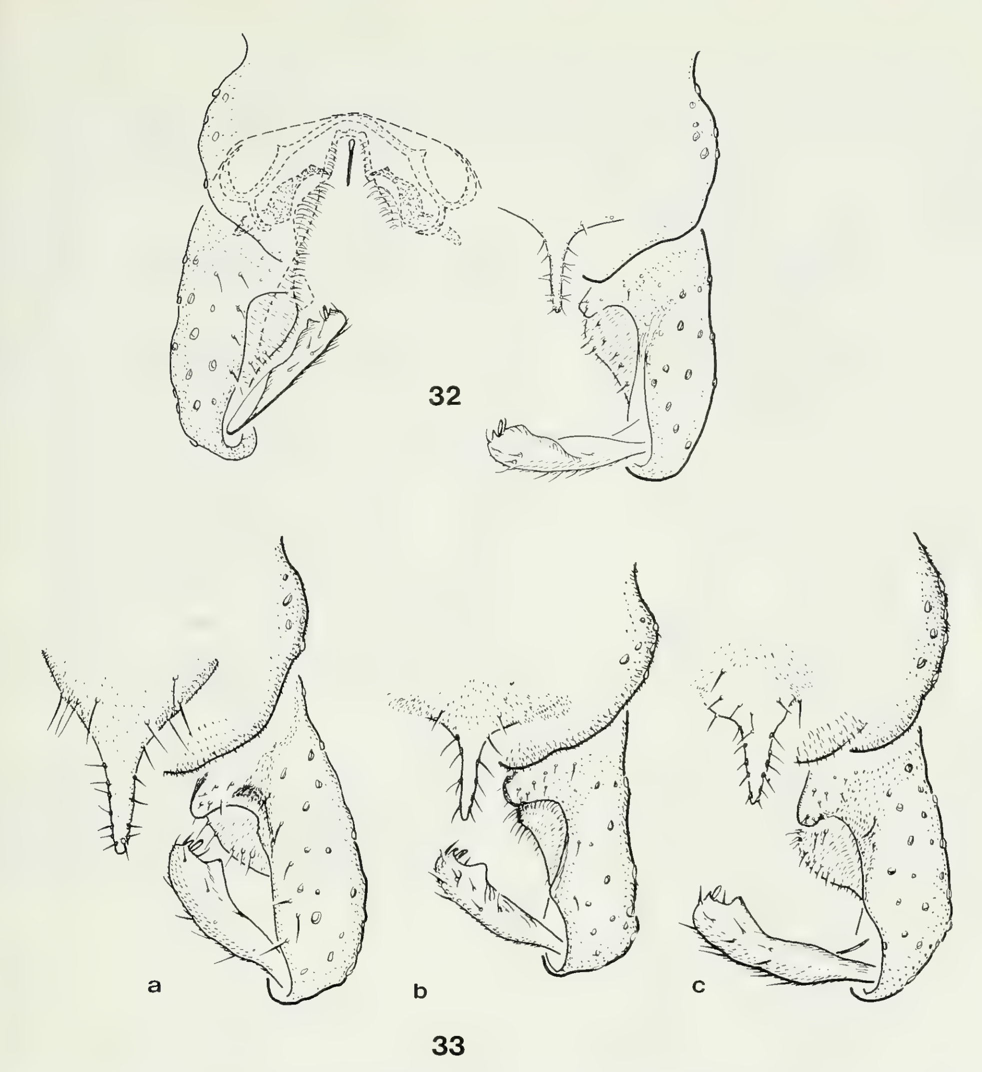
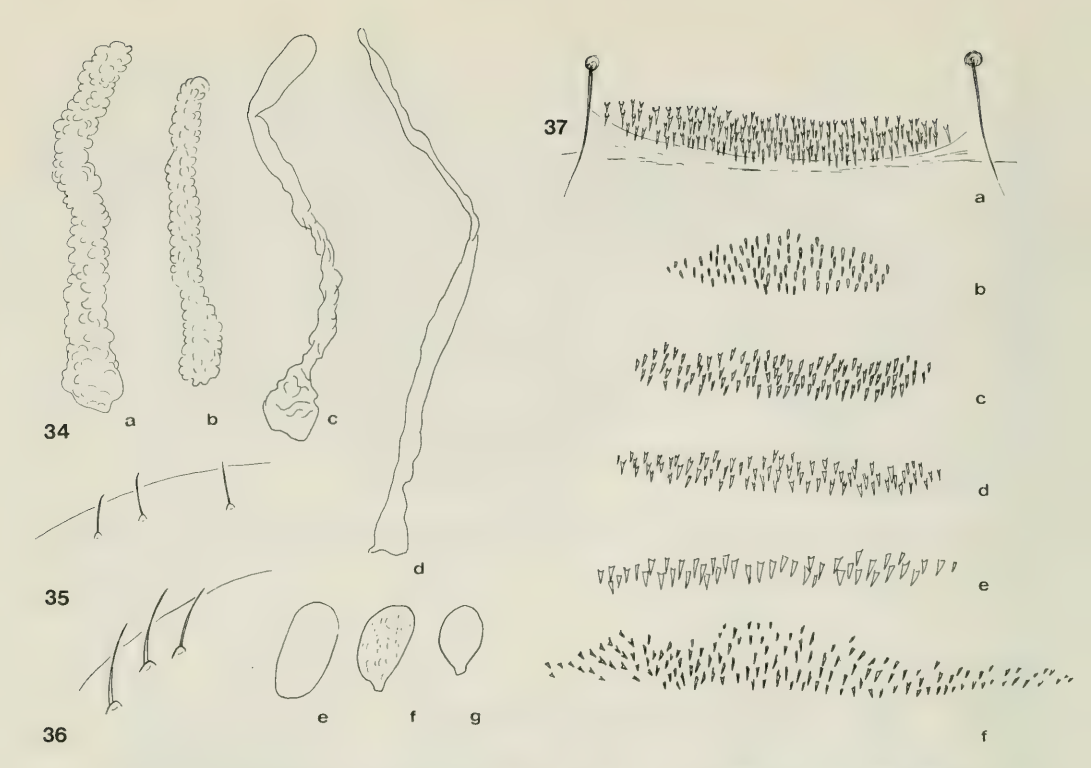


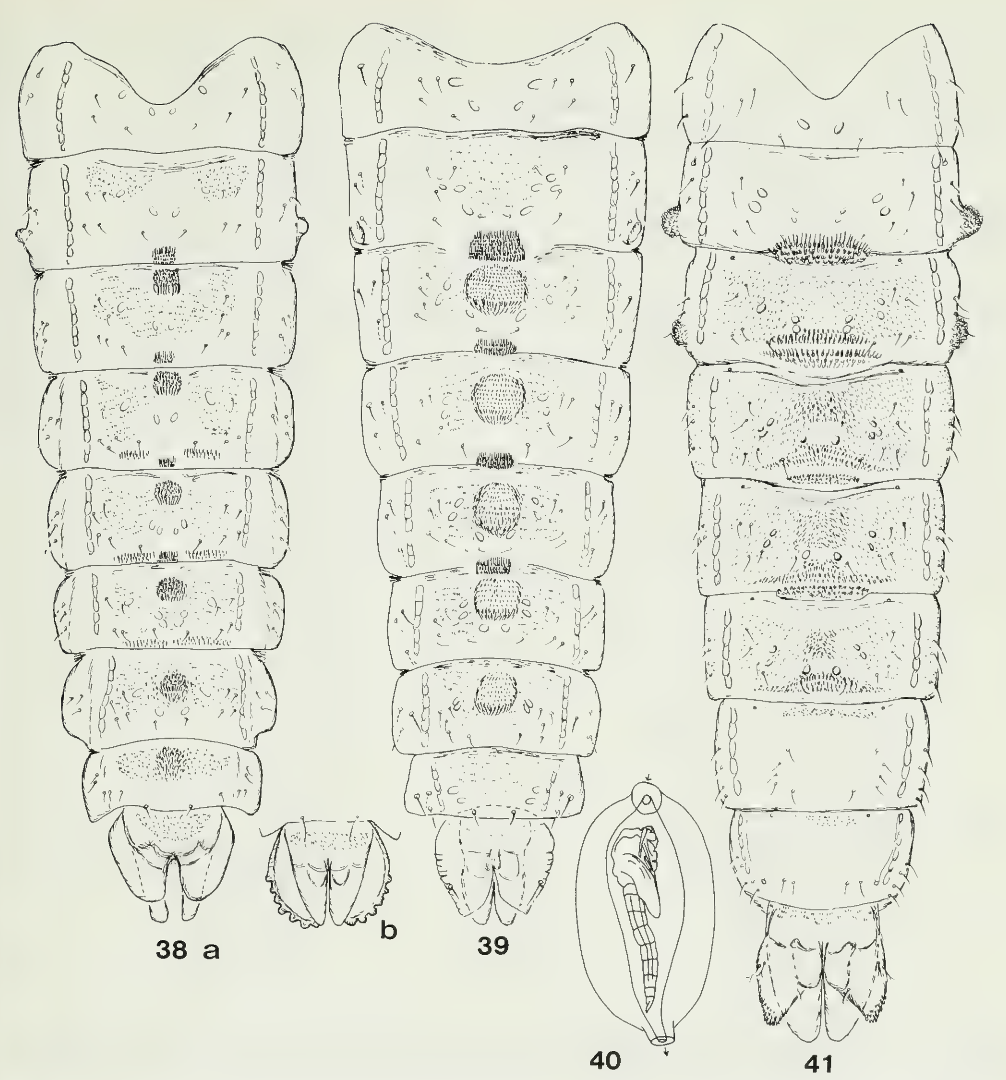
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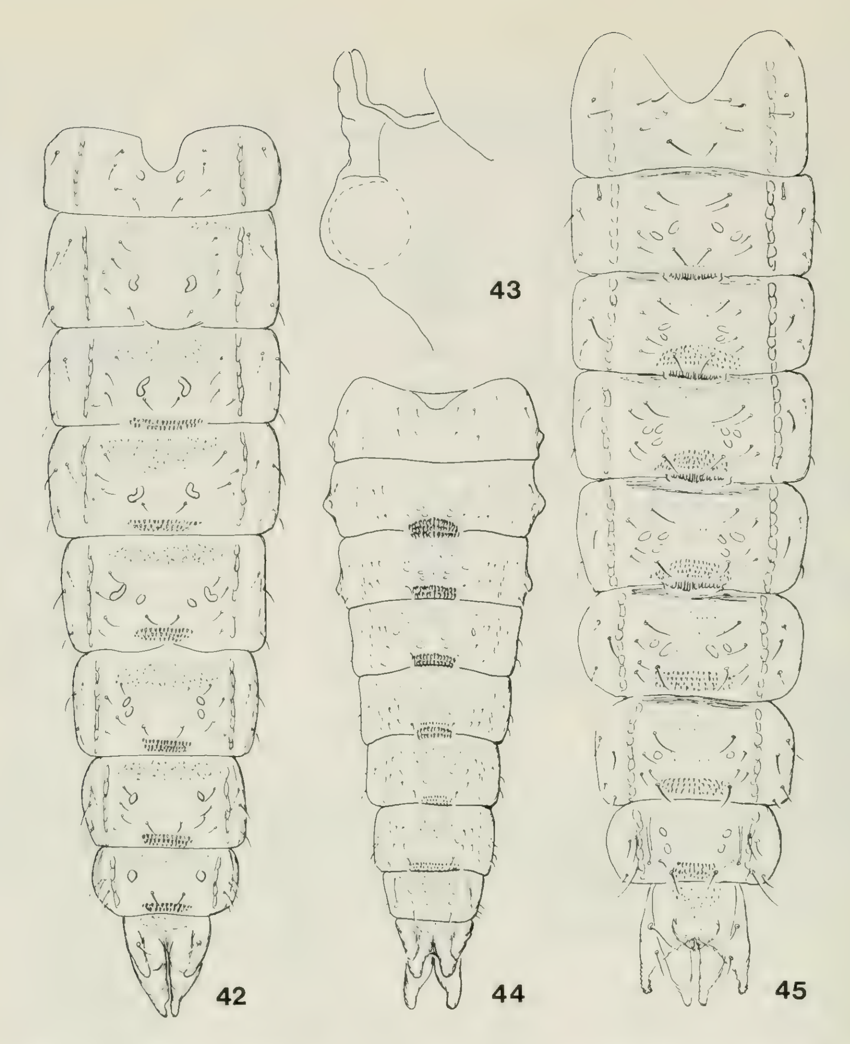
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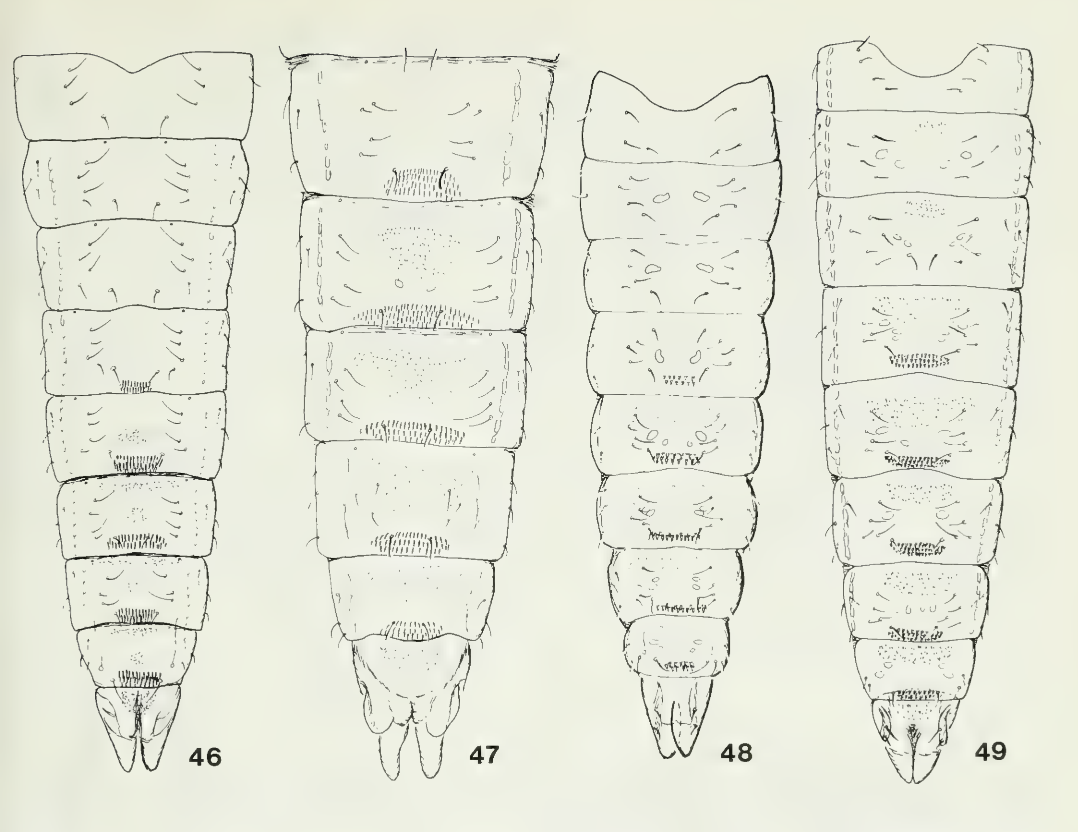
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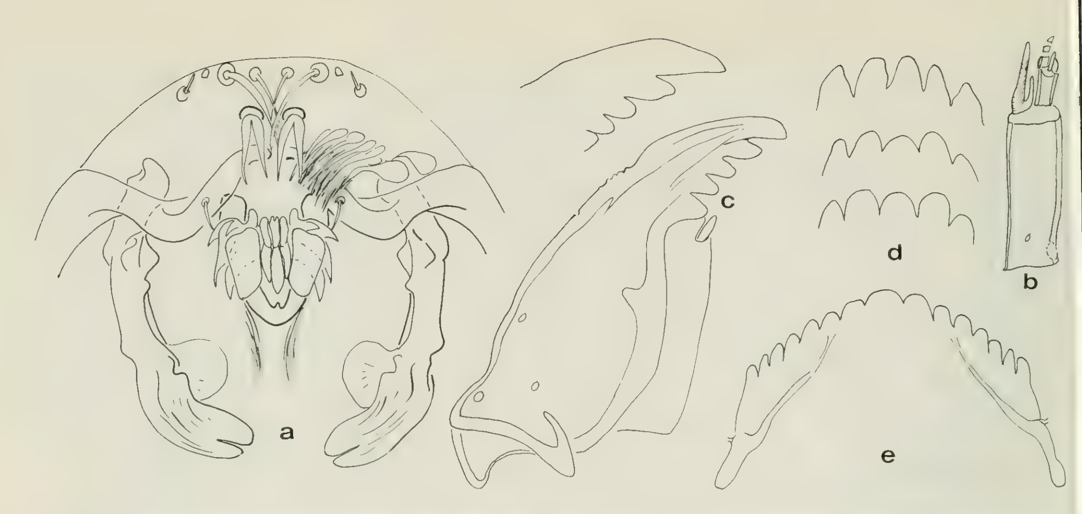


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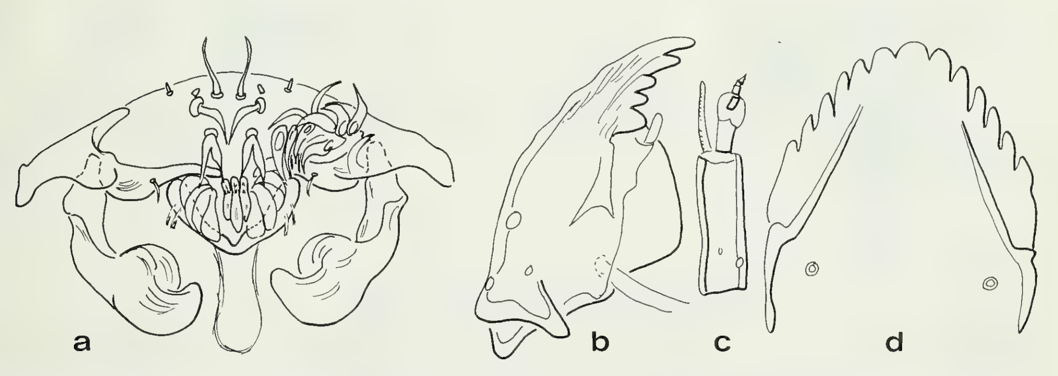


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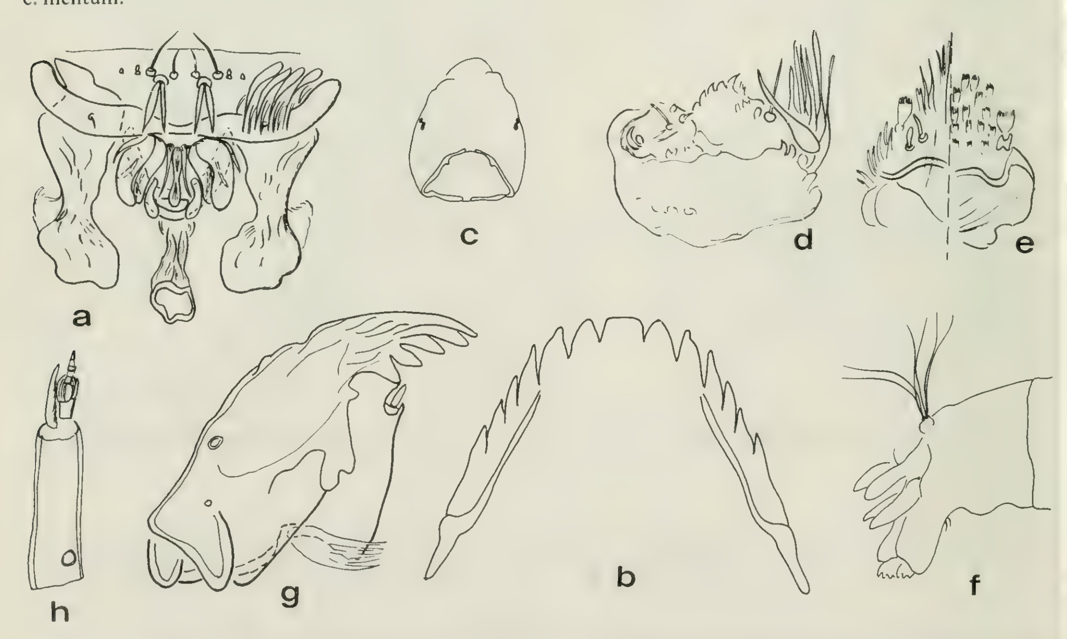


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E. J. Fittkau

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Gesamtherstellung: Gebr. Geiselberger, Altötting



Lars Brundin
1951.

Lars Brundin
zum 80. Geburtstag

Jeder, der heute mit Chironomiden arbeitet, ist im Grunde genommen ein Schüler von Lars Brundin. Er war es, der die Chironomidenforschung mit einem neuen Konzept in die 2. Hälfte unseres Jahrhunderts führte. Er setzte neue Maßstäbe auf diesem Gebiet der aquatischen Entomologie. Seine Zeichenkunst erschloß der Chironomidensystematik bislang entbehrte Grundlagen. Seine Arbeitskraft, Konzentrationsfähigkeit und Zielstrebigkeit demonstrierten, zu welch umfassenden Aussagen und Leistungen man bei Benthosuntersuchungen kommen kann. Seine große wissenschaftliche Begabung machte es ihm möglich, seinen taxonomischen Erfahrungsschatz und nicht zuletzt seine tiefe Naturliebe in phylogenetische und biogeographische Grundlagenforschung einzubringen. Er war wohl der erste Zoologe, der das Werk von W. Hennig: „ Grundzüge einer Theorie der phylogenetischen Systematik“ durchgearbeitet und seine grundlegende Bedeutung für die biologische Forschung erfaßt hat. Er wurde der überzeugendste Interpret Hennigs bis zum späteren weltweiten Durchbruch dieser Theorie.

Wir schätzen uns sehr glücklich, daß Prof. Brundin immer noch aktiv an der Chironomidenforschung und der Diskussion innerhalb der Phylogenie und Biogeographie teilnimmt. Zu seinem 70. Geburtstag widmete ihm die schwedische Entomologische Gesellschaft eine Festschrift. Dort erschien auch eine Würdigung seiner bisherigen vielseitigen und umfangreichen wissenschaftlichen Arbeit, einschließlich eines Verzeichnisses seiner Veröffentlichungen. Inzwischen liegt eine Reihe weiterer bedeutender Publikationen von ihm vor, bzw. sind im Druck.

Mit dieser Sammlung von chironomidologischen Beiträgen unterschiedlicher Forschungsrichtungen wollen seine Freunde, seine „Schüler“, Lars Brundin danken für seine wegweisenden Arbeiten, seine anregenden Gespräche, seinen gewichtigen Beitrag zur modernen Chironomidenforschung. Diesem Dank und dem Glückwunsch zum 80. Geburtstag schließen sich zahlreiche Freunde und Fachkollegen an, die sich an dieser Festschrift nicht beteiligen konnten.

30. Mai 1987

Ernst Josef Fittkau

INHALT – CONTENTS

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Changes in the profundal Chironomidae of Lake Mälaren during 17 years

By T. Wiederholm

Abstract

The profundal benthos of Lake Mälaren was sampled in September/October each from 1970 and onwards. Considerable fluctuations in population densities of the most abundant taxa occurred. In many cases the temporal patterns were similar between stations, indicating common causal mechanisms. The role of food, climatic conditions and biotic interactions is discussed.

Introduction

Lake Mälaren is the third in size of Sweden's lakes. The lake serves as a water supply to Stockholm and other surrounding communities, supports a significant fishery and is used for various recreational activities among the population of 1.1 million within its drainage area.

Limnological monitoring of Lake Mälaren and its main tributaries has been performed since 1966. Studies of the bottom fauna were started in 1969. Sampling network and methods have been the same since 1970. Earlier results were reported in Wiederholm (1974, 1978). In the present paper I describe the changes that have taken place among the major taxa of profundal Chironomidae and discuss the importance of trophic conditions and other factors to these changes.

Methods and material

Five Ekman samples (15×15×30 cm) were taken in September/October each year from 19 stations throughout the lake. Eight of these stations, representing the major subareas of the lake, are discussed here (Fig. 1). The sediments were washed through a 0.6 mm net and preserved in 70 % ethanol in the field. The samples were stained using Bengal Rose, sorted under microscope and the animals identified to species or genus (Chironomidae and others) or higher taxonomic level (Oligochaeta, Hydracarina). Data were stored and treated with the use of codes in Maitland (1977) (amended by myself and co-workers), Uppsala University's computer (SAS, own programmes) and PC:s (statistics and diagrammes in this paper).

The chemical and biological conditions in Lake Mälaren are described in detail by Willen (1984). The lake is composed of several more or less isolated basins. The western and northern parts are the most eutrophic, with considerable variation within and between years in phytoplankton biomasses and water chemistry. The central basins are deeper, somewhat colder and more homogenous temporally.

Results

General

The profundal Chironomidae of Lake Mälaren was predominated for the most part by seven taxa. *Chironomus anthracinus* Zett., *C. plumosus* L. and *Procladius* spp. dominated in the western and

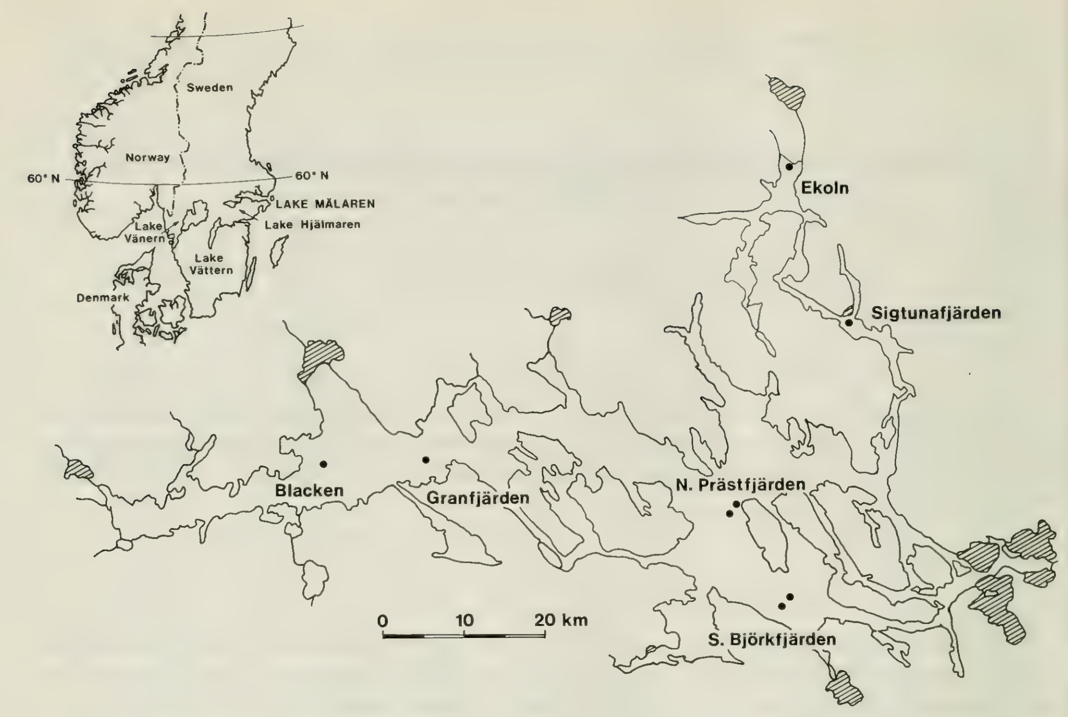


Fig. 1. Lake Mälaren with sampling stations.

northern basins (Blacken, Granfjärden, Ekoln and Sigtunafjärden in Fig. 1). *C. neocorax* Wülker & Butler occurred in western Lake Mälaren. *Micropsectra* spp., *Tanytarsus* spp. and *Procladius* spp. dominated in the central part of the lake, where *Chironomus* was absent. *Sergentia coracina* and *Stictochironomus* spp. were also part of the fauna of the central basins but in lower numbers than the other taxa.

It has not been possible to identify all larval material to species. Imagines of *Micropsectra* caught by hand-net at the central basins were identified as *M. insignilobus* Kieffer by SÄWEDAL (1976). Several species of *Tanytarsus* and *Procladius* have been found and at least two species of *Stictochironomus*, one of which was *S. rosenschoeldi* (Zett.), have been reported to occur in hand-netted material (WIEDERHOLM 1974). *Chironomus* larvae of the *salinarius* type from western Lake Mälaren were described as *C. neocorax* by WÜLKER & BUTLER (1983) and none of the other species with this larval type are likely to occur in the lake. The identity of *C. plumosus* and *C. anthracinus* has not been established from chromosome identifications, but these species are the most likely ones to occur in great numbers at the depth that has been sampled here, viz 15 m (cf. LINDEBERG & WIEDERHOLM 1979).

Considerable temporal variation in numbers have been noted for most groups of benthic organisms during the study period. Oligochaeta and Chironomidae decreased in numbers at most stations throughout the period. *Chaoborus flavicans* became more abundant during later years (station Blacken in Fig. 2). Crustaceans occurred in high numbers in the central part of the lake during some few years (station N. Prästfjärden in Fig. 2).

Chironomus anthracinus

C. anthracinus occurred in particularly high numbers in Blacken and Sigtunafjärden during the first part of the period (Fig. 3). The species then decreased at all stations and population density was rather low throughout the 1980's. Considerable variation occurred between individual years, and the corre-

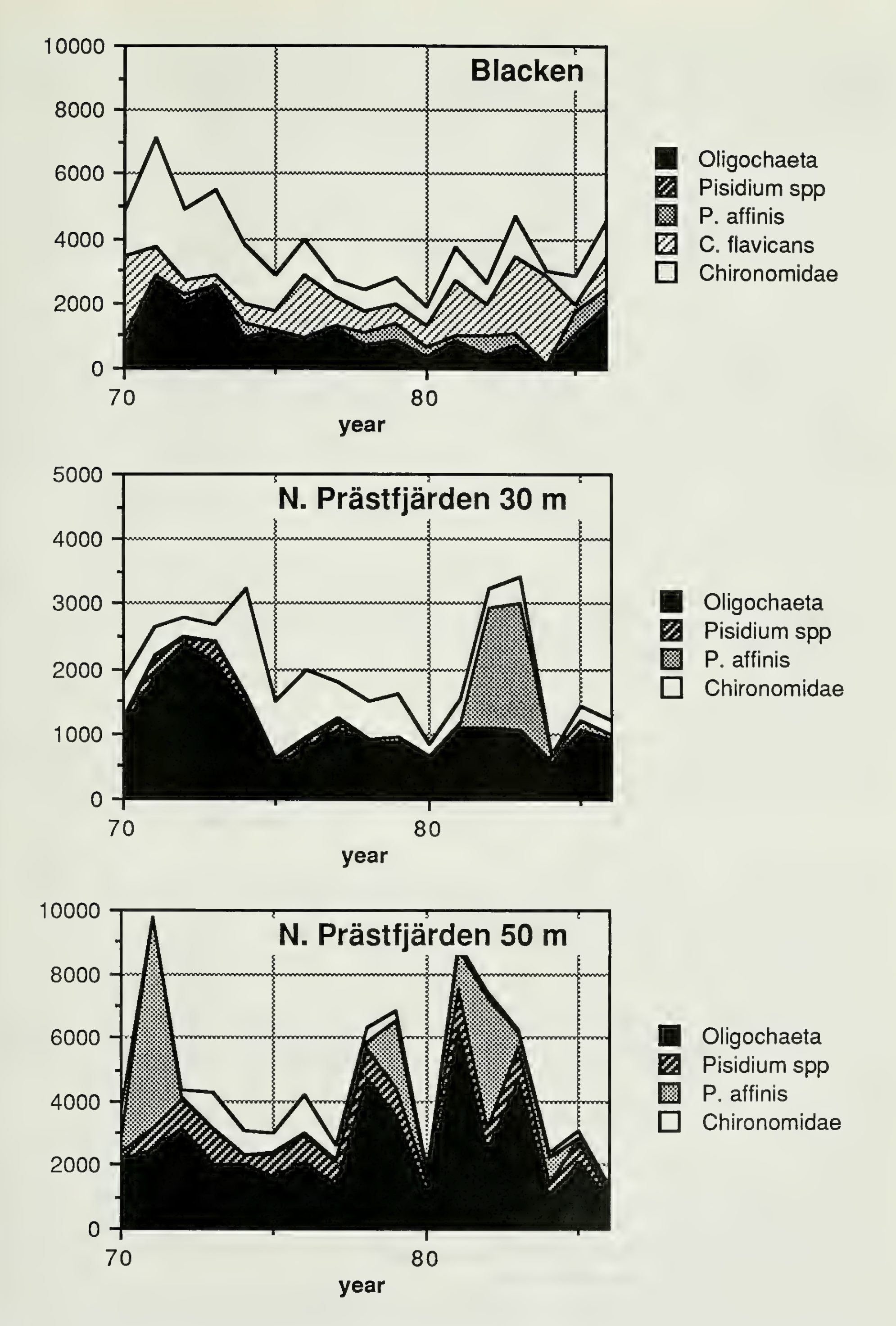


Fig. 2. Occurrence of major groups of benthic organisms 1970–1986 (ind. m^{-2}) in western (stn. Blacken) and central Lake Mälaren (stn. N. Prästfjärden).

lation coefficients between the various data sets for single years were low, except between Blacken and Sigtunafjärden. The general pattern of development was quite similar at all stations, however, as appears from the figures and the correlation coefficients for running means (Fig. 3, Table 1).

C. plumosus

C. plumosus fluctuated in numbers at most stations without any clear general trend or correlation between stations (Fig. 3, Table 1). High numbers occurred in Ekoln during the first part of the study period, but the population density decreased strongly at the end of the 1970's and remained low throughout the remainder of the study period.

C. neocorax

This species has a rather uneven distribution within Lake Mälaren. Similar to the other *Chironomus* species it is absent from the central basins, and it occurs in high numbers only in some of the moderately eutrophic western basins. Of the stations dealt with here, only Granfjärden had high population densities of *C. neocorax*, and there was no clear temporal pattern or correlation between stations (Fig. 3, Table 1).

Micropsectra spp.

Large numbers of *Micropsectra* were found during only a few years (Fig. 3). Distinct peaks occurred at all stations between 1973 and 1976 and the running means of the 30 and 50 m depths in both N. Prästfjärden and S. Björkfjärden were strongly correlated (Table 1). The overall occurrence of *Micropsectra* was low throughout the 1980's.

Tanytarsus spp.

The occurrence of *Tanytarsus* was similar to that of *Micropsectra* (Fig. 3). Peaks occurred at all stations in 1974 and 1976, and very low numbers were found after 1979. The data sets from the various stations were strongly correlated (Table 1).

Sergentia coracina

This species was rare or absent most years, but distinct peaks occurred in 1976 or 1977 in three out of four stations in the central part of Lake Mälaren (Fig. 3).

Stictochironomus spp.

Stictochironomus (not shown in figure or table) had its main occurrence in 1976–79, i. e. somewhat after the peaks of *Micropsectra* and *Tanytarsus*. Significant numbers were found only in N. Prästfjärden.

Procladius spp.

Two peaks occurred at the 30 m stations in central Lake Mälaren – one around 1976 and the other one in 1982–83 (Fig. 3). The running means from these stations were strongly correlated (Table 1). At 50 m depth in N. Prästfjärden the second peak was much less pronounced, but the general pattern was similar. The 50 m station in S. Björkfjärden showed much less variation, but the highest numbers occurred in the first part of the study period.

In the western and northern basins temporal variation was seemingly greater, without much similarity between stations (Fig. 3, Table 1). A general tendency to decreasing abundances may be noted, however.

The occurrence of *Procladius* was similar to that of *Micropsectra* and *Tanytarsus*. Running means of *Procladius* were strongly correlated to those of *Micropsectra* (r = 0.91–0.97) (not shown in table) at the 30 m stations, though less so at the 50 m stations (r = 0.17–0.38). There was also a positive correlation with running means of *Tanytarsus* or *Tanytarsus* plus *Micropsectra* (r = 0.65–0.91) at the 30 m stations, though again this trend was weaker at the greater depth.

Discussion

Considerable variation occurred between years. However, for most taxa trends or regular patterns of variation are clearly discernible. In many cases the similarity between stations, as indicated by high correlation coefficients between the data sets, indicates a common causal mechanism for the observed variation. For example, the high numbers of *Micropsectra*, *Tanytarsus*, *S. coracina* and *Stictochironomus* at most stations in central Lake Mälaren during the mid–1970's would seem to have a common reason. Decreasing numbers of *C. anthracinus* were common to the stations of western and northern Lake Mälaren and one may suspect a common structuring factor here also. The numbers of *Procladius* were strongly correlated at stations in the central part of the lake, but not at the western and northern stations, and this may indicate that different factors are predominating. No pattern could be seen in the numbers of *C. plumosus* and *C. neocorax*, except for the marked decrease of the former species at station Ekoln.

Food, weather conditions and biotic factors are important determinants acting independently or collectively in governing population density. Improved sewage treatment in all major communities around the lake has brought about a 50% reduction of the phosphorus loading on Lake Mälaren since the middle of the 1960's. The occurrence of a series of dry years up to 1976 added to this and the total phosphorus loading decreased to less than half of its maximum during the last 20 years. Evidently as a result of this, the excessive blooms of bluegreen algae in the western and northern parts of the lake decreased in intensity and duration (Willen 1987). Small species of algae (e. g. flagellates) became more common and the number of species increased. The average total biomass of algae did not decrease to any great extent, however, except for the most eutrophic parts of the lake.

The significance of these changes to the bottom fauna is not immediately clear. Both quantitative and qualitative changes in profundal food supply may have resulted. Because many of the small, non-colonial species of algae are more effective producers than large, colonial species, there is reason to believe that the total planktonic primary production per unit area is about the same as before or even higher. Measurements to support this conclusion are lacking, however. One might assume that a greater proportion of the phytoplankton is metabolized in the water column when small and mobile forms are more predominant. Bluegreens such as *Anabaena* are also metabolized in the water phase (Fallon & Brock 1980), but others sink and decompose on the lake bottom. This may result in increased sediment oxygen demand, but the increased microbial production favours many invertebrates that tolerate low oxygen levels. Among these are several species of Oligochaeta. Hence the reduced numbers of Oligochaeta in many parts of Lake Mälaren (cf. Fig. 2, station Blacken) may therefore be understood as reflecting a reduced nutrient flow through bacteria and sediments, resulting from the reduced occurrence of bluegreen algae.

Little information is available on food utilization of aquatic insects – certain types of ingested matter are probably of little value, whereas small amounts of other material may be critical (Lambertini & Moore 1984). *C. anthracinus* and *C. plumosus* are both detrivores, but algae sometimes make up a considerable part of the gut content (Jónasson 1972, Lambertini & Moore 1974). Johnson (1985) concluded that *C. anthracinus* is more of a deposit feeder, ingesting particulate matter scraped from the recently deposited surface sediments, whereas *C. plumosus* is a filter feeder with the nutritional quality of ingested matter depending primarily on pelagic inputs. This would explain the decreasing num-

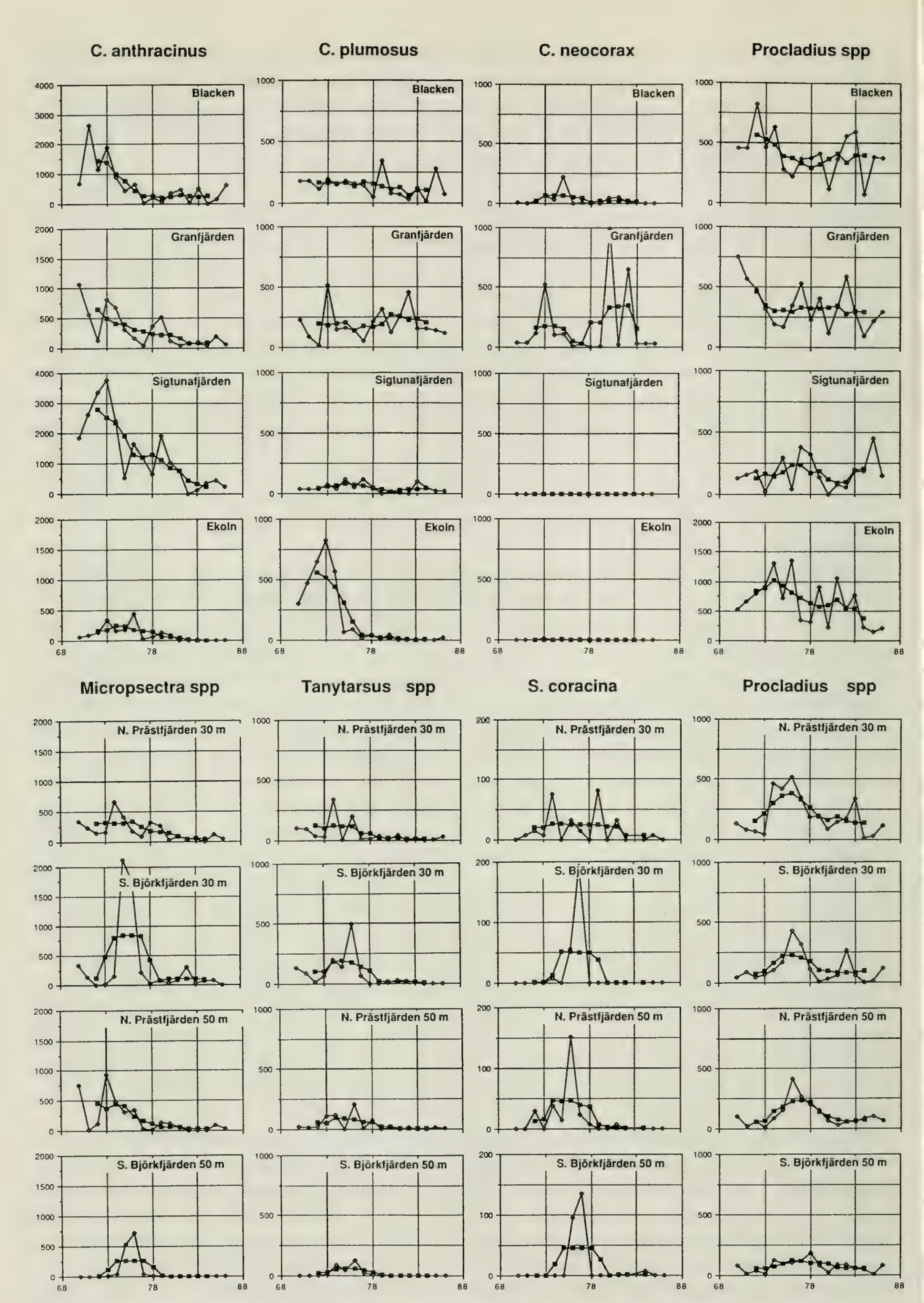


Fig. 3. Occurrence of major profundal Chironomidae 1970–1986; yearly and 5 yr running means (ind. m^{-2}). Please observe differences in scales.

bers of C. *anthracinus* if, as argued above, one accepts that the changes in phytoplankton species composition has increased the relative importance of the pelagic metabolism relative to that of the benthic one.

The decrease of C. *plumosus* at station Ekoln is probably more of a local change than part of a general pattern. Hypereutrophic conditions occurred at this station before effective sewage treatment was installed in the nearby city of Uppsala, and C. *plumosus* endured this better than C. *anthracinus*. It is surprising, however, that both species have decreased to virtual extinction during later years.

Contrary to the other species dealt with here, *Procladius* spp. are predominantly carnivorous, although algae and detritus may also be found in their gut content (TARWID 1969, BAKER & MCLACHLAN 1979). Oligochaetes, other chironomid larvae and small benthic crustaceans are the preferred prey. Data on the ocurrence of crustaceans are not available. There was a positive correlation between the running means of *Procladius* spp. and those of Oligochaeta at two of the four stations in western and northern Lake Mälaren. The correlation was negative and very weak at the central stations, where *Micropsectra* and *Tanytarsus* were better correlated with *Procladius*. This may indicate that the fluctuations in numbers of *Procladius* depended on fluctuations of their prey organisms, but it may also indicate that some of these taxa responded to some other factor that led to a common temporal pattern (cf. below).

Micropsectra, Tanytarsus, Sergentia coracina and *Stictochironomus* had their maximum occurrence during the mid–1970's. All are presumably browsers or filter feeders and typical inhabitants of the mesotrophic or moderately oligotrophic lake types as characterized by Brundin (1956). They were characteristic members of the profundal chironomid communities in the central part of Lake Mälaren throughout the study period dealt with here, but high population densities occurred only during a few years. It seems unlikely that this pattern would have been due to a directional change toward more mesotrophic or oligotrophic conditions that would have presented optimal conditions during these years only. Thus underlying factors with a more stochastic variation should be sought to explain the occurrence of these taxa. Weather conditions coincident with emergence may be one such factor. Calm and warm weather should be favourable to swarming, egg-laying, and hence the recruitment of young larvae, particularly in species with a short and well synchronized flight period. Phenological data is scarce, however, and the available information indicates rather long or even several flight periods. Imagines of *M. insignilobus* are common in May and June at the central basins of Lake Mälaren (WIEDERHOLM 1974). *Stictochironomus rosenschoeldi* and another species of *Stictochironomus* occur in June and July. Records of adult *Sergentia coracina* from southern and central Sweden include late June and September (BRUNDIN 1949); no adults have been found from Lake Mälaren. If one assumes that the 4th instar larvae found in September–October were born in the early summer the same year, weather conditions in May and June should be important. Weather records show that these months were particularly warm in 1976, with 230 day degrees above the average for 1970–85 and nearly 350 day degrees above the minimum during the period, which occurred in 1982. *Micropsectra, Tanytarsus* and *Sergentia coracina* had population peaks in 1976 at some stations. Peaks did occur in other years also, however, when temperatures were below average (e. g. 1985). Nevertheless it is still possible that the peaks in larval abundance that occurred during these years were related to weather conditions, but more detailed life history information is needed to support this conjecture.

Between 5000 and 10000 ind. m^{-2}, occasionally as much as 20000 ind. m^{-2}, of *Pontoporiea affinis* may be found at 50 m depth at station S. Björkfjärden (WIEDERHOLM unpubl.). The physical disturbance by such numbers of crustaceans should have a negative influence on the sessile, tube-living and rather fragile larvae of *Tanytarsus* and *Micropsectra*, and a strong negative correlation did occur between running means of *P. affinis* and the two chironomid taxa (r = −0.85 and −0.91, respectively). Hence, the absence of large numbers of *P. affinis* might be a prerequisite for *Tanytarsus* and *Micropsectra* to occur in reasonably large populations densities even during years when weather conditions and other circumstances were favourable to recruitment of young.

C. anthracinus

	Blacken	Granfj.	Sigtunafj.	Ekoln
Blacken		0.48/0.91	0.72/0.92	0.39/0.63
Granfj.	0.08/-0.51		0.60/0.98	0.34/0.78
Sigtunafj.	0.01/0.61	-0.22/-0.77		0.60/0.83
Ekoln	0.17/0.60	0.12/-0.32	0.08/0.51	

C. plumosus

C. neocorax

	Blacken	Granfj.	Sigtunafj.	Ekoln
Blacken		0.15/-0.47	-/-	0.11/0.71
Granfj.	0.46/0.60		-/-	0.21/-0.43
Sigtunafj.	-0.04/-0.28	-0.11/-0.27		-/-
Ekoln	0.34/0.55	0.08/0.26	-0.43/-0.07	

Procladius spp

Micropsectra spp

	N. Prästfj. 30	S. Björkfj. 30	N. Prästfj. 50	S. Björkfj. 50
N. Prästfj. 30		0.30/0.76	0.47/0.89	0.25/0.75
S. Björkfj. 30	0.68/0.89		0.20/0.59	0.95/0.99
N. Prästfj. 50	0.67/0.92	0.80/0.98		0.19/0.57
S. Björkfj. 50	0.75/0.85	0.92/0.99	0.82/0.97	

Tanytarsus spp

Sergentia coracina

	N. Prästfj. 30	S. Björkfj. 30	N. Prästfj. 50	S. Björkfj. 50
N. Prästfj. 30		0.05/0.59	0.28/0.64	0.06/0.60
S. Björkfj. 30	0.67/0.97		0.32/0.75	0.94/0.99
N. Prästfj. 50	0.65/0.87	0.73/0.94		0.60/0.82
S. Björkfj. 50	0.60/0.75	0.46/0.80	0.53/0.91	

Procladius spp

Table 1. Correlations between stations for the dominant chironomid species; yearly data/5 yr running means.

The deep profundal of temperate lakes is sometimes thought of as a zone of stable environmental conditions with little variation in population densities and community composition. The studies reported here are not the first to demonstrate that considerable fluctuations do occur (cf. Jónasson 1972, Holopainen & Jónasson 1983). Few time series exist, however, that describe long-term variation in profundal Chironomidae. Observations from such series may be used to formulate hypotheses on the role of abiotic factors, food, competition and predation to variation in population density and community structure. In particular, long series of field observations are the only practical way to assess the significance of climatic varation to population densities of profundal Chironomidae. To understand

the role of biotic interactions, more information is needed, in particular, on life histories of Chironomidae and how these are linked to seasonal variation of phytoplankton production and deposition of organic matter on lake bottoms.

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Lars Eriksson identified and counted the Chironomidae. Richard Johnson read the manuscript.

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Die weiblichen Gonodukte in normalen und parasitierten Chironomus Imagines*

(Diptera, Chironomidae)

Von **Wolfgang Wülker** und **Iris Herrmann**

Abstract

The histological and functional differences of the four sections of female *Chironomus* gonoducts are characterized by light- and ultramicroscopical techniques. The foremost part of the oviductus communis with its high (possibly glandular) epithelium may produce secretions with importance for egg transport or sperm activation. The second broad part with flat epithelium is able to store eggs after deliberation from the ovary. The third part, characterized by a muscular valve, restricts the egg passage to only one egg at a time. The genital chamber (vagina) is responsible for guiding the penis to the „Spermathekenmündungsplatte", insemination of ripe eggs, addition of mucus from the gluten gland and extrusion of the inseminated eggs. With regard to these functions, the actions of the „Spermathekenmündungsplatte", the attached coxosternapodemes and their musculature, and the processes protruding into the genital chamber from the lateral and ventral sides are discussed. Effects of mermithid worms (Nematoda) on *Chironomus* gonoducts are variable. Nevertheless, as a rule, the parasitogenic deficiencies begin from the oral components (oviduct, spermathecae). The „Spermathekenmündungsplatten" are often misshaped and restricted to the caudal part. In consequence, the coxosternapodemes have a rigid median connection and can not be moved in the normal way. Histologically, inhibition of development (e. g. oviduct), excess growth (e. g. intima) and disintegration (e. g. musculature) can be observed. Thus, the sterility of parasitized females is not only a matter of undeveloped ovaries, but also of the incompleteness, aberrant histological structure and functional incompetence of the gonoducts.

Einleitung

Die Änderung des Geschlechtsapparates von *Chironomus* durch parasitäre Mermithiden (Nematoda) ist lange bekannt (Rempel 1940, Wülker 1961, Rempel et al. 1962). Die weiblichen Imagines werden „kastriert", d. h. ihre Gonaden werden gar nicht ausgebildet (Rempel 1940) oder erreichen nur etwa 1/300 der normalen Größe und enthalten unentwickelte oder degenerierende Keimzellen (Wülker 1961, 1971). Das 8. Abdominalsternit, in dem die weiblichen Gonodukte ausmünden, verliert im parasitierten ♀ mehr oder minder die typischen Strukturen (z. B. geteiltes Borstenfeld, Subgenitalbucht, Notum, Öffnungen der Gonodukte) und wird damit scheibenartig wie beim ♂ (Wülker 1961, Götz 1964); die zugehörige Genitalimaginalscheibe des 8. Segmentes der Larve ist dementsprechend unvollständig (Wülker 1975).

Über die innen liegenden sekundären Geschlechtsmerkmale ist weniger bekannt. Die aus dem 9. Abdominalsegment des ♀ hervorgehende Schleimdrüse fehlt der parasitierten weiblichen Imago

* Der größte Teil der Untersuchungen wurde vom Erstautor bei der 64. Jahrestagung der Central States (Kansas) Entomological Society in Lincoln/Nebraska April 1985 vorgetragen.

oder ist winzig (1/1000 der normalen Größe, Götz 1964), ihre Anlage ist bei parasitierten Larven nur in Form eines ziemlich ungeordneten Zellhaufens vorhanden (Wülker 1961, 1975, 1976). Spermatheken, die aus der Genitalimaginalscheibe des 8. Segmentes hervorgehen, fehlen im parasitierten Tier (Rempel 1940, Wülker 1961, 1978, Götz 1964). Von den Geschlechtsausführgängen sagt Wülker (1961), daß sie meist nur in Andeutungen vorhanden sind, „die aber nur kurz verfolgt werden können und beim weiblichen Intersex keine Verbindung zum rudimentären Ovar haben". Nach boraxkarmingefärbten Totalpräparaten sind sie auf eine Zellmasse am Hinterrand des 8. Segmentes der Imago beschränkt (Wülker 1978), einige zugehörige Muskeln (M. dilatator vaginae, M. dil. oviducti) können identifiziert werden, sind aber unvollständig. Histologische und funktionelle Betrachtungen sind bei normalen Imagines selten (z. B. Wensler & Rempel 1962, Photographien in Saether 1977), für parasitierte fehlen sie völlig.

Wir haben bei histologischen Untersuchungen an *C. anthracinus* Zett und *C. riparius* K. gefunden, daß schon die Gonodukte normaler weiblicher Imagines unbekannte Strukturen bieten, die der morphologischen und funktionellen Betrachtung wert sind. Bei Parasitierung von *C. anthracinus* durch *Limnomermis anthracini* Kaiser, Wülker & Skofitch 1987 wollten wir feststellen, welche der Gonoduktabschnitte und Strukturen im parasitierten ♀ zumindest fragmentarisch gebildet werden, ob sie typische oder aberrante Form haben, und wieweit die Gonodukte noch zu ihrer normalen Funktion geeignet erscheinen.

Material und Methoden

Es wurde hauptsächlich an Imagines von *Chironomus anthracinus* Zett. aus Freilandfängen vom Schluchsee/Hochschwarzwald (930 m über NN) gearbeitet. Zur Ergänzung ist der leicht im Labor züchtbare *C. riparius* K. herangezogen worden. Beide Arten unterscheiden sich in den hier betrachteten Strukturen nur unwesentlich.

Zur Analyse des zellulären Aufbaus bestimmter Strukturen eignet sich alk. Boraxkarminfärbung nach Fixierung in Carnoy (Romeis 1968). Selektive Darstellung der chitinisierten Teile mit der üblichen KOH-Behandlung (10 %). Die mazerierten und gründlich gewässerten Hinterenden können dann zur Untersuchung bestimmter Teile (z. B. Spermathekenmündungsplatte) mit Mikronadeln präpariert und für rasterelektronenmikroskopische Darstellung vorbereitet werden. Dazu werden die Objekte in üblicher Weise in Acetonstufen entwässert, critical point-getrocknet (Balzers Union, CPD 020) und mit Gold beschichtet. Betrachtung in einem Nanolab 7 ZEISS. Die histologischen Schnittserien sind nach Fixierung der Objekte in Glutaraldehyd (6 %) in Cacodylatpuffer, Nachfixierung in 1 % OsO_4, Entwässerung über Alkohol/Propylenoxid und Einbettung in Epon mit 1 μm Dicke auf einem Reichert Om U2 Ultramikrotom geschnitten und mit Toluidinblau gefärbt. Lebendbeobachtungen der Imagines nach leichter Betäubung mit Äther. In der Terminologie der beobachteten Strukturen folgen wir Saether 1980.

Ergebnisse und Diskussion

Gonodukte normaler Imagines

Am caudalen Ende der beiden Ovarien findet sich in Querschnittserien unreifer ♀♀ der zunächst zweigeteilte, dann einheitliche Zellpfropf, der den Eiern den Eintritt ins Ovar versperrt (vgl. Wensler & Rempel 1962, Fig. 45). Es gibt, wie schon Abul Nasr (1950) festgestellt hat, keine paarigen lateralen Ovidukte. Vielmehr beginnt das Lumen des Ovidukts (odc) gleich unpaar und ist von voluminösen Zellen (Abb. 2 a) umgeben. Dieser Anfang des ersten Oviduktabschnittes liegt noch im 7. Abdominalsegment und ist durch das große Ganglion (g), in das dasjenige des 8. Segmentes eingeschmolzen ist, von der Ventralwand des Segmentes getrennt. Es gibt Hinweise auf drüsige Zellkomplexe und sekretorische Funktion in diesem Abschnitt, was in Übereinstimmung mit dem Vorhandensein von Drüsen im Ovidukt bei Culiciden (Clements 1963) und der Produktion von Gleitsekreten oder Sekreten zur Spermienaktivierung bei anderen Dipteren (z. B. *Drosophila,* Übersicht Sander 1985) stünde.

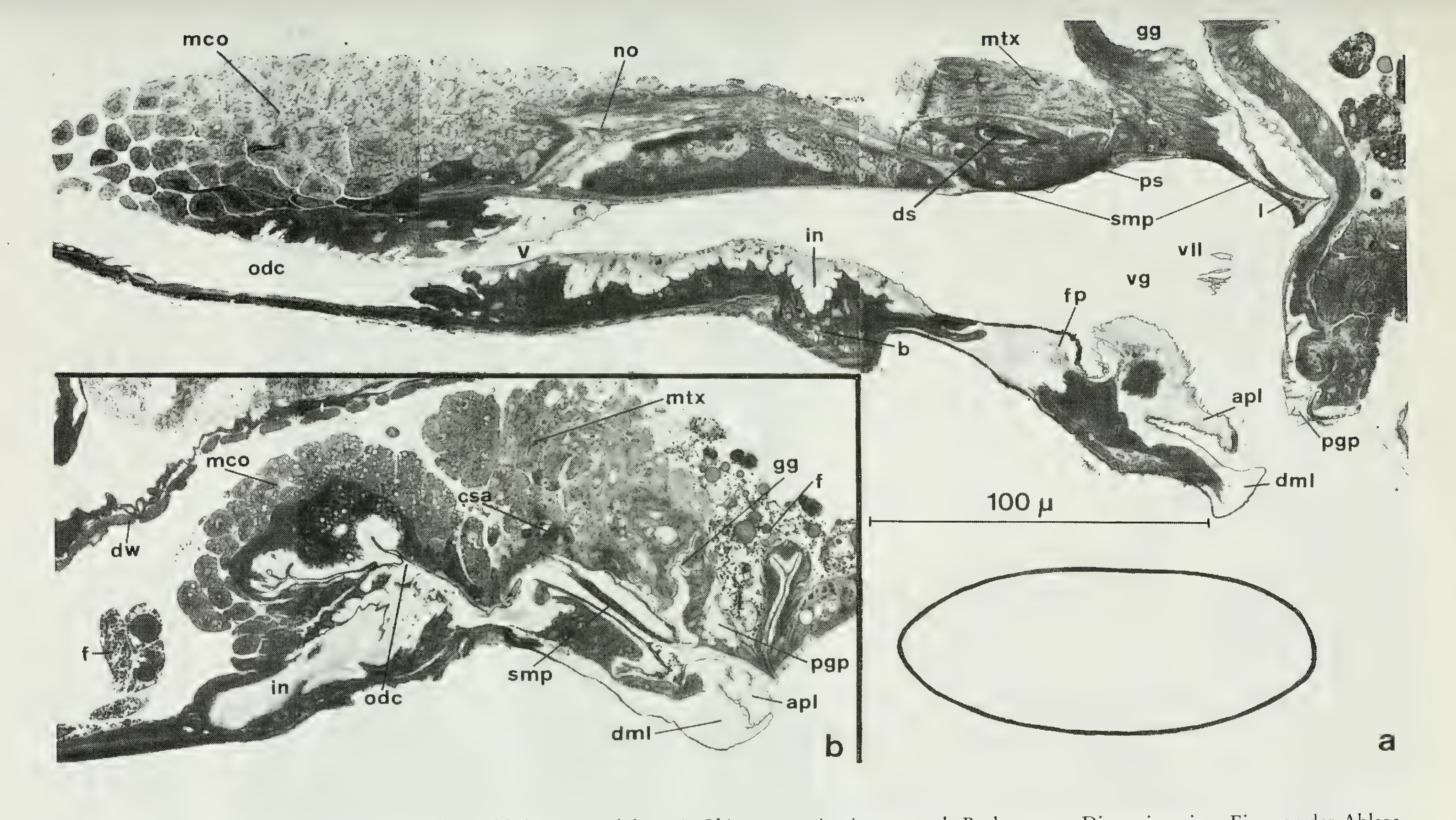


Abb. 1: Parasagittale Längsschnitte durch die weiblichen Gonodukte. a) *Chironomus riparius,* normal. Rechts unten Dimension eines Eies vor der Ablage. b) *C. anthracinus,* parasitiert. Gleiche Vergrößerung wie in a)!
apl = Apodemlobus (Gonapophyse VIII), b = Bogen (Vorderrand d. Subgenitalbucht), dml = Dorsomesallobus, ds = Spermathekengang, dw = Darmwand, f = Fettkörper, fp = fingerförmige Fortsätze (finger-like processes), gg = Schleimdrüse (gluten gland), in = Chitinintima, l = Labien, mco = Musculus constrictor oviducti, mtx = M. transversus des Coxosternapodems, no = Notum, odc = Oviductus communis, pgp = Postgenitalplatte, ps = Spermathekenöffnung, smp = Spermathekenmündungsplatte, v = Ventil des odc, vg = Vagina, vll = Ventrolaterallobus.

Der zweite Oviduktabschnitt (nicht abgebildet) ist kurz und besteht aus flachen Zellen, die ein ebenfalls sehr flaches Lumen zwischen sich haben und der Außencuticula unmittelbar benachbart sind. Auf rasterelektronenmikroskopischen (REM) Präparationen ist dieser Abschnitt oft auf- oder abgerissen und hinterläßt auf der Cuticula einen etwa rhombenförmigen Abdruck von beträchtlicher Breite (ca. 120 μm). Vermutlich werden in diesem Abschnitt im reifen Weibchen die aus dem Ovar ausgetretenen Eier gespeichert. Unmittelbar dorsal von ihm liegen die Spermatheken.

Der dritte Oviduktabschnitt (Abb. 1a, 2b) ist durch Vorhandensein der voluminösen Ovidukt-muskulatur (M. constrictor oviducti, mco, M. dilatator oviducti, mdo) gekennzeichnet, die an einem im Querschnitt T-förmigen Apodem, dem Notum (no, Gabelapodem), ansetzen. Zunehmende Mächtigkeit des Epithels läßt eine Art Ventil (v) entstehen (Abb. 1a), das den Durchtritt einzelner Eier reguliert. Lebendbeobachtungen am narkotisierten Tier machen diese Einzelabgabe von Eiern unmittelbar deutlich. Da der M. constrictor oviducti schräg am Notum ansetzt (Wensler & Rempel 1962, Morisch & Wülker 1987), wird bei seiner Kontraktion nicht nur der Ovidukt verengt, sondern gleichzeitig das Ei nach hinten gezogen.

Als Vagina (vg, Genitalkammer, Abb. 1a) kann schließlich derjenige Oviduktabschnitt bezeichnet werden, in dem sich die Übertragung des Samens in die Spermathek (evtl. mit Hilfe einer Spermatophore, Nielsen 1959, Saether 1977), die Besamung der reifen Eier sowie ihre Versorgung mit Schleim und ihre Austreibung abspielt.

Die dorsale Wand der Vagina beginnt mit der Spermathekenmündungsplatte smp (pelvis-like structure Nielsen 1959, small flat plate Wensler & Rempel 1962, zeichnerische Darstellung bei Götz 1964

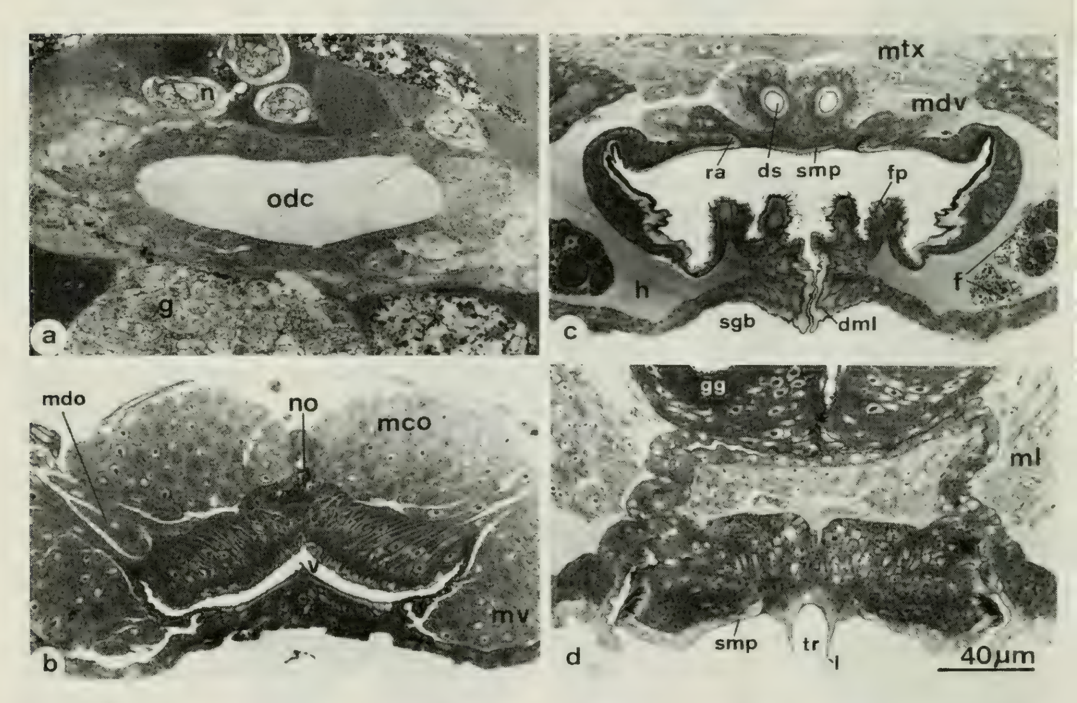


Abb. 2: *C. anthracinus*, Querschnitte durch die weiblichen Gonodukte. a) In Höhe des ersten Oviduktabschnittes, b) in Höhe des dritten Oviduktabschnittes, c) in Höhe der fingerförmigen Fortsätze (Vagina), d) in Höhe des hinteren Teiles der smp (Labien). Schleimdrüse entsprechend ihrem Knick nach hinten zweimal getroffen.
g = Ganglion, h = Hämolymphe, mdo = Musculus dilatator oviducti, mdv = M. dilatator vaginae, ml = M. lateralis, mv = M. ventralis, n = Nerv, ra = Rami des Notums, sgb = Subgenitalbucht, tr = „Trichter". Andere Abkürzungen wie in Abb. 1.

und Saether 1977). Mit der Dorsalfläche der smp sind oral die Rami des Notums (ra, „Äste des Gabelapodems" Götz 1964), seitlich die Spangen des Coxosternapodems (csa, Lateralspangen bei Götz) fest verbunden (Abb. 3a) und bilden mit ihr eine sklerotisierte Einheit. Die Vordergrenze der smp ist schwer erkennbar, weil die Stärke des Chitins hier kontinuierlich abnimmt. Stärker chitinisiert ist der beckenähnliche Teil (Abb. 3c), dessen Vorderrand zur Mitte hin dunkler und hakenartig erscheint (hk, offenbar die „Haken" bei Götz, die er jedoch der Subgenitalbucht zurechnet). Nach vorn begleitet aber noch eine schwächere, immer mehr verjüngte Chitinplatte den unpaaren Teil des Notums (Abb. 3a).

In der Mitte der smp findet sich eine ovale Region, die wir als „Spermathekenmündungsfeld" (smf, Abb. 3a, c, d) bezeichnen. Das smf erscheint hell, weil es nur von der durchsichtigen Intima ausgefüllt ist. Diese springt etwas in die Genitalkammer vor (se, Abb. 3b, „Spermathekeneminenz" Saether 1977) und wird vom unpaaren Spermathekengang durchbrochen. Der Hinterrand des smf ist dorsad wulstartig verstärkt (Abb. 3a, c). Die hintere Fläche der smp liegt unmittelbar vor der Schleimdrüsenöffnung (ggo) und ist räumlich kompliziert gestaltet. Im parasagittalen Längsschnitt (Abb. 1a) sieht man einen schräg nach unten abgeknickten Teil, der den Ausgang der Schleimdrüse abdeckt. In einem REM-Präparat, in dem mehr oder minder zufällig die Schleimdrüse (und die Verbindungsmembran zur Postgenitalplatte) nach hinten abgerissen war (Abb. 3b), ist weiterhin erkennbar, daß in der Mitte dieser schrägen Fläche ein nach ventral offener konischer Trichter (tr) liegt, dessen Ränder stellenweise mit kleinen Zähnchen bestanden sind.

Die Funktion des Komplexes aus smp, Notum und Coxosternapodem muß in bezug auf die Kopulation einerseits, die Besamung und Austreibung des Eies andererseits analysiert werden. Bei der Begattung wird der Penis dem smf zur Spermien-(oder Spermatophoren-)abgabe nahegebracht (Reiss 1966). Von hinten direkt auf das smf gerichtet ist die trichterartige Aussparung im hinteren Teil der smp, sie könnte dem Penis die nötige Führung geben. Da über der Dorsalseite der smp ein starker Muskel (M. transversus) die Knickstellen des linken und rechten Coxosternapodems verbindet (Wensler & Rempel 1962, Morisch & Wülker 1987) und die schwach chitinisierte smp sicher elastisch ist, dürfte der Trichter im Ventralbereich bei der Kontraktion des Muskels sich weiter öffnen (Abb. 2b, d). Ein anderer Muskel (M. dilatator vaginae, mdv) setzt im wesentlichen an der (nach außen schrägen) Außenfläche der Rami des Notums (ra) an (Abb. 2c). Bei seiner Kontraktion wird das smf gedehnt und damit vielleicht die Öffnung des Spermathekenganges zur Besamung des Eies freigegeben. Möglich ist außerdem, daß bei der erwähnten Kontraktion des M. transversus die Mitte der smp so nach vorne gestoßen wird, daß diese Bewegung zum Ausstoß des Eies beiträgt. Der M. lateralis (ml, Abb. 2d), der vom Coxosternapodem zum Hinterrand des 9. Tergits verläuft (Wensler & Rempel 1962, Morisch & Wülker 1987), zieht Coxosternapodem und smp dorsad und macht dementsprechend die Genitalkammer für den Eidurchtritt geräumiger. Lebendbeobachtungen haben gezeigt, daß die Spangen des Coxosternapodems bei der Eiablage lebhaft in deren Rhythmus bewegt werden, ebenso wie die mit ihnen muskulös verbundenen Cerci, die sich beim Eidurchtritt weit öffnen. Vorher wird jedoch das Ei noch mit dem quellbaren Schleim umgeben, der für Gelege von *Chironomus* typisch ist. Das Epithel um die breite Schleimdrüsenöffnung (ggo) ist an der schrägen Hinterfläche der smp gewissermaßen ausgespannt (Abb. 3d) und wird nur von häutigen Anhängen dieser Hinterfläche, den Labien, median überdeckt. Durch diese Gebilde könnte der in jedem Gelege median verlaufende, helixartig gewundene „Zentralfaden" (Strenzke 1959, „twisted fibres" Miall & Hammond 1900) bei seinem Austreten aus der Schleimdrüse geführt und von den beidseitigen Schleimströmen umgeben werden.

In der ventralen Wand des Ovidukts beginnt am sog. „Bogen" (Götz 1964, vgl. auch b in Abb. 3c) ein medianer Spalt, der die beiden Dorsomesalloben (dml) der Gonapophyse VIII voneinander trennt (REM-Darstellung Morisch & Wülker 1987). In diesem Spalt sind zahlreiche fädige Gebilde, wahrscheinlich Sensillen, nachweisbar, deren Funktion wahrscheinlich im Zusammenhang mit der Begattung wichtig ist. In diesem Spalt wird wahrscheinlich der Steg des T-Träger-artigen processus analis

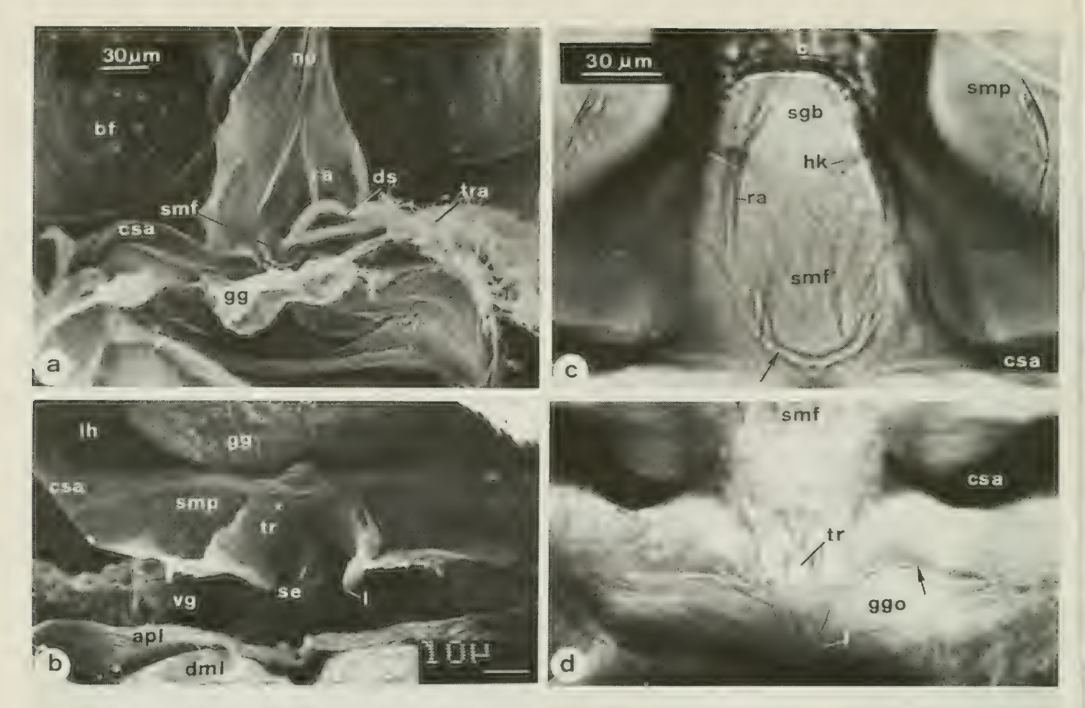


Abb. 3: Spermathekenmündungsplatte. a) *C. anthracinus*, Gesamtansicht mit Blickrichtung auf die dorsale Oberfläche der smp (vom Körperinneren her!). REM nach KOH-Mazeration. Schleimdrüsenrest verdeckt hinteren Teil der smp. b) *C. anthracinus*, Einblick von hinten in die Genitalkammer, Ventralseite unten. Schleimdrüse und Verbindungsmembran zur Postgenitalplatte nach hinten abgerissen. c) *C. anthracinus*, vorderer Teil der smp in Ventralansicht, KOH-Mazeration. Pfeil = wulstiger Hinterrand des smf. d) *C. riparius*, hinterer Teil der smp mit Trichter und Labien, Ventralansicht. Boraxkarminfärbung. Man beachte, daß das vordere Epithel der Schleimdrüsenöffnung (Pfeil) der Hinterfläche der smp fest anliegt. Gleicher Maßstab wie in c)
bf = Borstenfelder des 8. Abdominalsternites (von innen gesehen), csa = Coxosternapodem, ggo = Schleimdrüsenöffnung, hk = „Haken", lh = Leibeshöhle, ra = Rami des Notums, se = Spermathekeneminenz, sgb = Subgenitalbucht, smf = Spermathekenmündungsfeld, tr = „Trichter", tra = Tracheen um Spermathekengänge. Andere Abkürzungen wie in Abb. 1.

des männlichen Hypopygiums geführt, während dieser in die Subgenitalbucht eindringt (Reiss 1966). Wenn er sich dem Bogen nähert, ist im Körperinneren der Penis dem smf nahe und der Transfer von Spermien oder Spermatophoren muß eingeleitet werden. Die fädigen Gebilde erstrecken sich nach hinten bis zu den bisher unbeschriebenen, in Abb. 2c dargestellten „fingerförmigen Anhängern" (fp), auf denen zahlreiche Borsten stehen. Weiter caudad sind dann auf dem parasagittalen Schnitt der Abb. 1a zwei Loben der Gonapophyse VIII (Dorsomesal- und Apodemlobus, dml, apl) sichtbar. Da das Ei (Abb. 1a) größer ist als das Lumen der Genitalkammer, klaffen diese Loben bei Eiaustritt weit auseinander (Lebendbeobachtung). Der dritte Lobus (Ventrolaterallobus, vll) der Gonapophyse, der lange Borsten trägt, ragt von der Seite in die Genitalkammer. Unsere Arbeitshypothese ist, daß das Ei in der Genitalkammer durch diese ventralen und seitlichen Stützen (oder Sensoren) in eine Lage gebracht wird, in der die zum Spermieneintritt geeignete Region der Eihülle (Micropyle?) zur Spermathekenöffnung orientiert ist. Ein solcher Vorgang würde den hohen Besamungsprozentsatz (nahe 100) bei *Chironomus* erklären und auch mit dem bei anderen Dipteren beobachteten Prinzip des „alignment" der Eier in Genital- oder Besamungskammern übereinstimmen (z. B. *Musca* Leopold, 1980, Übersicht Sander 1985). Auch Wensler & Rempel 1962 haben die Ventrolateralloben als „egg-guides" angesehen.

Zusammenfassend sind wir der Meinung, daß eine Abschnittsgliederung der Gonodukte von *Chironomus* vor allem nach den aufeinanderfolgenden Funktionen (1. Sekretbeigabe ?, 2. Eispeicherung, 3. Durchlaß einzelner Eier, 4. Begattung, Besamung, Schleimzugabe) sinnvoll ist. Auch strukturelle Grenzen sind, wie Wülker et al. 1979 angedeutet haben, brauchbar, aber eher willkürlich. Die funktionellen Vorstellungen, die wir aus den morphologischen Befunden abgeleitet haben, sind vorwiegend Arbeitshypothesen, die mit weiteren Untersuchungen, vor allem Beobachtungen am lebenden Tier, Klärung der Frage, ob und wo eine Mikropyle vorhanden ist, ultramikroskopische Untersuchung der Borsten an den fingerförmigen Fortsätzen und Ventrolateralloben und Beobachtungen über die zeitliche Reihenfolge von Eireifung, Begattung, Übertritt der Eier in den Oviductus communis und Eiablage geprüft werden müssen.

Gonodukte parasitierter Imagines

Schnittserien durch das Abdomenende parasitierter Weibchen führen ebenso wie die äußere Inspektion der 8. Abdominalsternite (Wülker 1961, Götz 1964) zu sehr unterschiedlichen Ergebnissen; kein Tier ist dem anderen gleich. Die Skala reicht von noch guter Erkennbarkeit der Gonoduktteile bis zur Beschränkung auf eine mehr oder weniger undefinierbare Zellmasse am Ende des 8. Abdominalsternites (vgl. Wülker 1978). Als Beispiel für unsere Befunde zeigt Abb. 1 b noch relativ gut strukturierte Gonodukte: Der Ovidukt ist verkürzt und erreicht nur etwa die Mitte des 8. Abdominalsegmentes. Ein Oviduktlumen ist nur auf manchen Schnitten sichtbar. Der Ovidukt ist in mehrere Ausläufer aufgeteilt, der Musculus constrictor oviducti im Umfang reduziert, jedoch in normaler Position. Weiter caudal sind linkes und rechtes Coxosternapodem durch die hier verstärkte smp in der Mitte starr verbunden. Dorsal ist ein kräftiger M. transversus aufgelagert, der hintere Teil der smp ist meist vorhanden. Bei Betrachtung im REM ist manchmal auch seine trichterförmige Einsenkung (S. 21) noch erkennbar. Der vordere Teil der smp ist dagegen meist mißgestaltet oder fehlt. Die Schleimdrüse ist ein begrenzter Zellkomplex. Ventral der Genitalkammer schließlich liegt eine hypertrophierte Gonapophyse VIII, deren Dorsomesal- und Apodemlobus nicht mehr klar voneinander abgrenzbar sind. Bemerkenswert ist die aberrant starke Entwicklung der Chitinintima.

Trotz der Variabilität der Befunde an parasitierten Weibchen ergibt sich als Regel, daß die morphogenetischen Mängel der Gonodukte oral beginnen (Ovidukt, Spermatheken) und caudad fortschreiten. Ähnlich hat Baumert-Behrisch (1960) bei Strepsipterenbefall der Zikade *Calligypona* nur bei 7 von 44 Imagines den Ovidukt, aber bei 32 die Vagina ausgebildet gefunden.

Histologisch ist erstens davon auszugehen, daß in den wachstumsgehemmten Bereichen der Zellzyklus verlangsamt ist (Wülker 1978). Zweitens scheint das normale entwicklungsphysiologische Programm der Zellen in Richtung auf aberrante hypertrophe Bildungen geändert. Drittens wird der normale Zellverband gelockert und irregulär. Befunde an Totalpräparaten haben gezeigt (unveröff.), daß z. B. die Muskulatur von Ovidukt und Vagina, wenn sie beim Wachstum median eine nur noch unvollständig eingesenkte Subgenitalbucht mit mangelhaft ausgebildeten Gonodukten „antrifft“, sich regellos und ohne nennenswerten Zellverbund von einer Segmentseite zur anderen ausspannt („criss-cross“-Muster der Muskulatur). Zelldegeneration schließlich wurde in unseren Befunden nicht direkt nachgewiesen, ist aber nach Erfahrungen am geschädigten Ovar (Wülker 1971) früher oder später auch in den geschädigten Gonodukten zu erwarten.

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Thalassosmittia atlantica (Storå) comb. nov. Description of adult female and immature stages from Tenerife, Canary Islands

(Diptera, Chironomidae)

By P. D. Armitage and J. Tuiskunen

Abstract

Descriptions of adult female, pupa and larva of the species *Eukiefferiella atlantica* Storå are presented. On the basis of these new data and re-examination of adult males the species is transferred to *Thalassosmittia*.

Introduction

Armitage (1986) redescribed the male of *Eukiefferiella atlantica* Storå from type material and specimens collected in December 1983 over rock pools at El Medano, Tenerife. Generic placement of the species was however still in doubt and further data were required to confirm its identity. In December 1985 collections at the same site were made by P. D. A. in and around rock pools. These collections contained *E. atlantica* males, together with associated females which keyed-out to *Thalassosmittia* Strenzke & Remmert with Saether (1977) although the Tenerife specimens had finely pubescent eyes. In addition, pupal exuviae and last instar larvae associated with the adults were also identified as *Thalassosmittia* from descriptions given in Strenzke & Remmert (1957). Further evidence for the new combination is provided by adult males of *E. atlantica* which key-out to *Thalassosmittia* with the most recent key to holarctic adult male Orthocladiinae (Cranston et al., in prep.). The species *atlantica* Storå is therefore transferred to *Thalassosmittia*.

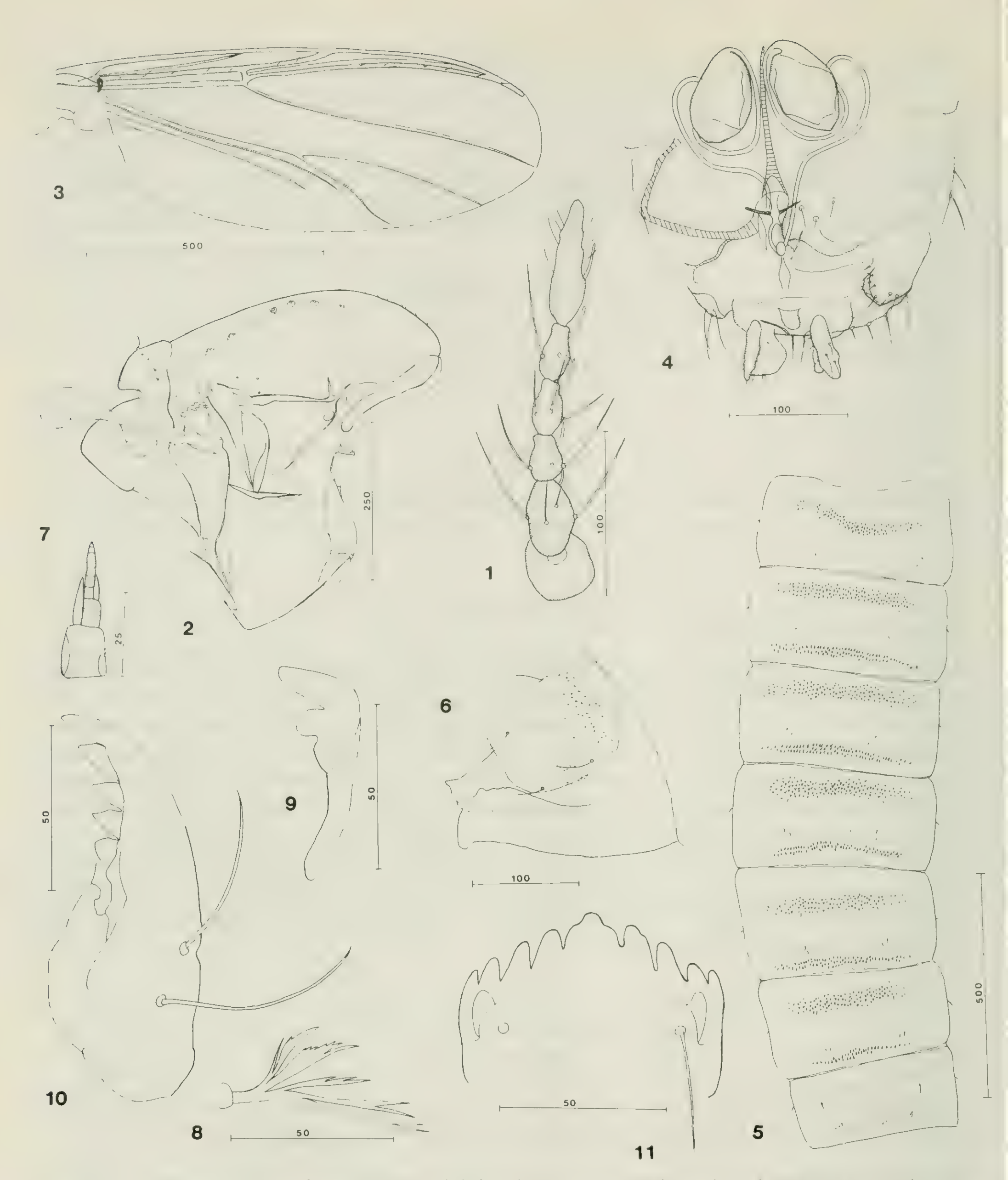
Thalassosmittia atlantica (Storå) comb. nov.
(Figs. 1—11)

Eukiefferiella atlantica Storå (1936). Lectotype (♂ imago, specimen A) Tenerife, Puerto Cruz, coll. R. Frey 28.7.1931. Slide mounted lectotype deposited in Zoological Museum, Helsinki, Finland.

Adult female (n = 6)

Colour: Abdomen and ground colour of thorax greenish grey. Scutal stripes well separated, brown. Wings pale brown.

Head: Temporal setae 4—5, clypeals 17—25. Eyes not produced dorsally, with pubescence. Palps 5-segmented, lengths of 4 ultimate segments: 18—26 μm, 38—50 μm, 44—62 μm, 74—88 μm. Sensilla clavata of segment 3 lacking. Antennal flagellum (Fig. 1) 5-segmented, lengths of segments: 48—60 μm, 30—40 μm, 32—42 μm, 32—42 μm, 68—86 μm. AR 0.46—0.52. Sensillar setae present on all flagellar segments.



Figs 1–11. *Thalassosmittia atlantica* (Storå): adult female, 1 Antenna, 2 Thorax lateral, 3 Wing. 4 Genitalia; pupa, 5 Tergites II–VIII. 6 Tergite IX and genital sac (♂); larva, 7 Antenna, 8 Seta interna of mandible, 9 Premandible, 10 Mandible, 11 Mentum. (Bar lines in μm.)

Thorax: (Fig. 2). Antepronotals 0 (rarely 1). Some very weak and curved acrostichals present in anterior $^1/_3$–$^1/_4$ of thorax. Dorsocentrals 7–11, uniserial, arising from pale spots. Prealars 3, scutellars 6–8 in one row.

Wing (Fig. 3): Membrane without macrotrichia. Granulation fairly coarse, visible at a magnification of ×100. Veins bare except R with 4–8, R_1 with 2–4 and R_{4+5} with 7–10 setae. Brachiolum with 1 seta. Squama bare. Costa extending beyond R_{4+5}, free end about 70–100 μm. R_{2+3} poorly separated, reaching wing margin near the tip of R_{4+5}. Cu_2 slightly curved. Anal lobe moderately developed. Wing length 1.05–1.24.

Legs: LR (P_1) 0.44–0.49, P_2 0.44–0.45, P_3 0.52–0.57. All tibiae with one spur. Length of front tibial spur 20–22 μm, mid tibial spur 20–22 μm and hind tibial spur 22–26 μm. Hind tibial comb with 9–11 setae. Pulvilli lacking. BR of hind tibia 2–3.

Genitalia (Fig. 4): Gonocoxite with 3–6 longer and 3–7 shorter setae. Cercus 50–80 μm long. Seminal capsule oval, with indistinct neck, 75–80 μm long and 46–56 μm broad. Seminal duct with a loop.

Pupa (n = 2)

Total length 2.0–2.3 mm. Colour: pale brown, thorax somewhat darker than abdomen.

Cephalothorax: Thoracic horn absent. Frontal setae obviously lacking (not identifiable on both slides examined). Frontal warts normally developed. One postorbital seta present. Verticals absent. 2 moderately developed medial antepronotals, 3 precorneals of about equal length. 4 dorsocentrals, 2 of which very short. Thorax somewhat rugulose dorsally. Wing sheaths smooth.

Abdomen: Tergite I without shagreenation. Spinules of tergites II–VIII as in Fig. 5. Medial spinule group very weak, lacking on tergite II–IV but present on V-VIII. Spinules of anterior group directed backwards but those of posterior group forward, consisting of 2–4 rows of spinules. Spinules of anterior and posterior groups distinctly weaker in segment VIII than in other segments. Sternites I–IV without shagreenation. Sternites V–VIII with 2–3 rows of moderately strong spinules near posterior margin of segment, and a group of very weak, irregularly arranged spinules on the anterior part of sternites. Coffman et al. (1986) refer to conjunctives of both tergites and sternites. These do not occur in the present specimens and are not shown in the figure of *Thalassosmittia* in Langton (1984). Poorly developed pedes spurii A present on sternites II–VI. Pedes spurii B absent.

Chaetotaxy of abdomen: Dorsal setae of segment II–VIII as in Fig. 5. II–VIII with 3 weak, VIII with 2 somewhat longer setae. Setae of tergite I not visible on examined exuviae. Lateral setae obviously 1 on each segment. Ventral setae 3 in each sternite except VIII with 1. Tergite IX (Fig. 6) more or less rectangular, with posteriorly directed spinules on anterior half and with 2 moderately long setae. Genital sac with ventral groups of well developed spinules.

Larva (n = 2) (fourth instar)

Body length 2.4–2.7 mm. Head capsule 280–360 μm long. Body colour (after preservation) pale, head capsule brown with mentum, mandibles and caudal margins darker brown.

Head: Antenna (Fig. 7) 5-segmented, lengths of segments: 16 μm, 8–10 μm, 4–6 μm, 5–6 μm. AR 1.63. Antennal blade 20 μm long, antennal style 7 μm long. Labrum: SI setae with about 6 branches, other S-setae simple. Pecten epipharyngis indistinct in preparations. Premandible (Fig. 9) 54–66 μm long, dark brown apically, pale basally. Mandible as in Fig. 10, 100–120 μm long, with 5 teeth. Seta interna of mandible as in Fig. 8, with 4–5 branches. Mentum (Fig. 11) with single pointed (or rounded) median tooth and 4 pairs of more or less pointed lateral teeth. At sides of the mentum a pair of toothlike structures arising from the ventral surface. Width of mentum 84–90 μm.

Body: Parapods present divided and short. Anterior parapods with both simple and serrate claws. Posterior parapods with simple claws only. Procercus absent. Remaining features of anal segment not clear in specimens available.

Discussion

Thalassosmittia was erected by STRENZKE & REMMERT (1957) for the species *thalassophila* Bequaert & Goetghebuer. The genus also includes 3 Nearctic species formerly in *Camptocladius* van der Wulp, *pacificus* Saunders 1928, *marinus* Saunders 1928 and *clavicornis* Saunders 1928, and a species from Japan *nemalione* Tokunaga 1936 formerly in *Spaniotoma (Smittia)*. To these five holarctic species can now be added *T. atlantica* (Storå) which is known at present from the Canary Isles, the Azores and Madeira. Male adults of *atlantica* may be separated from the other palaearctic species *T. thalassophila* on the hypopygium which is distinctive in *T. thalassophila*. Other points of difference are the A. R. (0.68 in *thalassophila*, 0.29 in *atlantica)* and the eyes which are bare in *thalassophila* and finely pubescent in *atlantica* (ARMITAGE 1986).

The ecology and life histories of the 3 Nearctic species are discussed in MORLEY & RING (1972b) and a key to these species (as *Saunderia* Sublette 1967, spp.) is presented in MORLEY & RING (1972a). TOKUNAGA (1936) provides detailed descriptions of all life history stages of *T. nemalione* which is found in algal mats in the tidal zone of rocky shores in Japan. STRENZKE & REMMERT (1957) give similar information for the western palaearctic species *T. thalassophila*. All 6 Holarctic species are found in the marine littoral zone. The genus is widely distributed in the Holarctic region and further collections in the southern hemisphere may reveal a worldwide distribution.

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Some records of two rare chironomid species in the Netherlands

(Diptera, Chironomidae)

By **B. P. M. Krebs***

Abstract

Recent finds of two rare chironomid species in the Netherlands are described. *Dicrotendipes pallidicornis* Goetgh. has been found in two small brackish waters in the southwest of the Netherlands. *Parachironomus mauricii* Kruseman was collected from a freshwater ditch in the north of the Netherlands. Both finds are compared with reports from elsewhere in and outside Europe.

Introduction

In this article the Dutch records of the rare Chironomid species *Dicrotendipes pallidicornis* Goetghebuer and *Parachironomus mauricii* Kruseman are considered. *D. pallidicornis* is a new find for the Netherlands. This species was found at two places in the Delta-region in the south-west of the Netherlands.

Since the description of *P. mauricii* by Kruseman in 1933, this species was not found in the Netherlands until 1979 when it was rediscovered by dr. W. van Vierssen in Friesland in the northern part of the Netherlands (Van Vierssen, 1982). Both species will be dealt with here.

Dicrotendipes pallidicornis Goetgh.

D. pallidicornis was first described by Goetghebuer (1934) on the basis of material collected on 13 to 15 April 1926 at Basra, Iraq, close to the Persian Gulf. Since then the species has been reported from several European countries. In the collection of the Zoologische Staatssammlung in Munich, FRG, I found some specimens from several parts of Europe, as indicated below (a to c):

a) One came from Lake Kurnas on Crete, Greece, collected by Dr. H. Malicky (Biological Station Lunz, Austria) on 16-5-1971. Dr. Malicky kindly supplied some chemical information about Lake Kurnas: it is an oligotrophic brackish water lake with a chlorinity that varied between 4.8 and 8.0 ‰ Cl^- during the period 1972–1980. The find of an adult doesn't necessarily indicate that it came from this lake.

b) The second specimen was one collected by Setta (Mendl) on 30–9–1975 at Lake Pineto, near Bastia, Corsica. About this find no further details are known.

c) On 7–8–1978 R. Kühbandner caught one male on the surface of a freshwater pond near Novalja on the island Pag, Yugoslavia. As above, this doesn't indicate that the midge grew up in this lake as a larva.

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* Communication nr. 387, Delta Institute for Hydrobiological Research, Yerseke.

The following references were found in the literature. Prat (1980) reports the species from the Cala reservoir near Sevilla in the south of Spain. It is a male, caught on 16-3-1974 and was by that the first known Spanish record of this species. Birkett (1984) described some finds of England. On 19 August and 1 September 1975 he visited the sandhills at Sandscale Hawes Warren in Cumbria and caught males and females. The species is established in this part of north-west England, shown by frequent subsequent captures. Since then the species has been found by Langton in Swan Pool, near Falmouth, Cornwall, south-west England in a partly brackish pool. Birkett's conclusion is that these records suggest a discontinuous distribution at present, and he is expecting that further collecting in and around coastal dune slacks may reveal the species to be more widespread.

The finds for the Netherlands are listed below:

a) The first sampling-station was the Doolman, a "weel" on Zuid-Beveland in the Delta-region. A "weel" or "wiel" is a round pool which is a result of a dikeburst. The Doolman has a diameter of approx. 50 meters and its largest depth is 5 meters. It contains brackish water; the chlorinity in 1978 fluctuated between 1.70 and 1.90 ‰ Cl^-. In 1975 fluctuations were somewhat larger: 2.60–5.90 ‰ Cl^-. In the deeper parts of the pool a vertical salt gradient existed. Locally, the shallower parts were grown with reeds and the substrate consisted of soft mud. *D. pallidicornis* was found while sampling this shallow litoral zone on 6-4-1978 and 11-7-1978. On these sampling days the chlorinity was 1.90 and 1.70 ‰ Cl^-, respectively. Collected larvae were reared in the laboratory. Identifications of the midges were confirmed by dr. R. Lichtenberg (Naturhistorisches Museum, Vienna). *D. pallidicornis* from 6-4-1978 was found in combination with larvae of *Procladius choreus* (Meigen) and *Glyptotendipes barbipes* (Staeger). For the 11-7-1978 sample *Chironomus salinarius* Kieffer, *Chironomus annularius* Meigen, *Chironomus halophilus* Kieffer and *Cricotopus ornatus* (Meigen) were additional to the combination mentioned before.

b) The second sampling-station was a in 1975 newly created pool in the recreational area "Het Poelbos", also on Zuid-Beveland. This pool, which was sampled on 15-3-1978, is rather shallow with reeds *Phragmites australis* (Cav.) Trin. ex Steud, salt-marsh club-rush *Scirpus maritimus* L. and bulrush *S. lacustris* L. growing on its shore. The submerged vegetation consisted largely of *Ranunculus* sp., *Potamogeton pectinatus* L. and *Myriophyllum spicatum* L. Chlorinity at that time was 0.92 ‰. Again, collected larvae were reared in the laboratory. Besides *D. pallidicornis*, we identified *G. barbipes*, *C. halophilus*, *C. annularius*, *C. salinarius*, *C. plumosus* (L.), *Microchironomus deribae* (Freeman), *C. ornatus* and *P. choreus*, a species composition that shows close resemblance to the combination found in the Doolman.

Table 1

Species	Brackish water-species	Freshwater species with moderate tolerance for brackish water	Freshwater species with slight tolerance for brackish water	Reference
Chironomus halophilus	×			Parma & Krebs, 1977
Chironomus annularius		×		Parma & Krebs, 1977
Chironomus salinarius	×			Parma & Krebs, 1977
Chironomus plumosus			×	Parma & Krebs, 1977
Glyptotendipes barbipes		×		Parma & Krebs, 1977
Microchironomus deribae	×			Krebs, 1979
Cricotopus ornatus		×		Krebs, 1982
Procladius choreus		×		Krebs, 1982

Both the additional species from the Doolman, as well as those from the Poelbos are rather common in the southwestern part of the Netherlands and typical for oligohaline-mesohaline waters (Table 1). For the species composition of the accompanying macrofauna see Table 3.

From the above, the tentative conclusion can be that *D. pallidicornis* shows a preference for slightly brackish water. The question, whether it is a true brackish water species or a freshwater species with a tolerance for brackish water has to remain unanswered due to a lack of sufficient data. The Dutch and English data do suggest the former.

FITTKAU & REISS (1978) classified *D. pallidicornis* as being a species of stagnant lakes. On basis of the Dutch records, we could add to this the smaller (brackish) waters. *D. pallidicornis* is likely to have at least two generations a year, because larvae of the species were found both on spring (March) and on summer (July).

Parachironomus mauricii Kruseman

W. van Vierssen (Landbouwhogeschool, Wageningen, The Netherlands) sent me some chironomids reared from larvae collected in several pools and ditches in Friesland in the norther part of the Netherlands. One of these samples was especially interesting since it contained *P. mauricii.*

This species has originally been described by GOETGHEBUER (1931) as *Cryptochironomus littorellus.* The description being based on a specimen collected on 8-9-1931 at "de Panne", a dune area in the southwest of Belgium. The species name "littorellus" gave rise to some confusion since Meigen used it also for another species. Therefore KRUSEMAN (1933) renamed the species *Parachironomus mauricii,* "mauricii" referring to Goetghebuer's Christian name.

For the Netherlands, Kruseman reports 2 finds. One concerns a specimen from his own collection and collected in the dunes near Vogelenzang in May 1931; the other one being a specimen from the "de Meijere-collection" and caught near Diemen, Noord-Holland, in September 1920.

LEHMANN (1970) reports the species in his revision of the European *Parachironomus* species. Besides the finds from Belgium and the Netherlands, Lehmann reports the species for Germany as well (though with a questionmark) and concludes that nothing is known about its lifecyle.

In the collection of the Zoologische Staatssammlung Munich two male specimens were found. One of these came from the Netherlands and was identified by Kruseman as *Parachironomus varus limnaei* Guibé, but renamed by Reiss as *P. mauricii.* About the origin of this material no further details are known. The second specimen, collected by Prof. Feliksiak in 1954 came from the region of Lodz, Poland. About this find we have no additional information either.

P. mauricii is also known from England. Langton found this species in Flood's Ferry, near March in Cambridgeshire (CRANSTON, 1974).

The first record for the Sovietunion comes from SHILOVA (1976) who reared 4 males from larvae collected in an artificial pond with a depth of 70 cm and a muddy, sandy bottom. The pupae hatched by the end of May and July.

Table 2

Potamogeton pectinatus L.	25 %
Zannichellia pedunculata Rchb.	20 %
Lemna gibba L.	20 %
Lemna trisulca L.	10 %
Potamogeton pusillus L.	10 %
Green algae	10 %

As stated above, the most recent Dutch find was done in Friesland by W. van Vierssen on the 22nd of August, 1979. Larvae of *P. mauricii* were collected from a small ditch, running through arable land. Its breadth was 2.5 m, and depth approx. 40 cm. The substrate consisted of clay. The water was very clear and its level did not fluctuate. The vegetation is given in Table 2 (after van Vierssen, 1982). For the species composition of the accompanying macrofauna see Table 4.

Unfortunately, the chlorinity is unknown, but regarding the species composition of the vegetation, the water will have been fresh or slightly brackish at the most. Rearing of larvae resulted in 2 males and 6 females. Other species either were not present or did not hatch. After identification the midges were compared with specimens from the collection in Munich.

Like *D. pallidicornis*, Fittkau & Reiss (1978) consider *P. mauricii* to be a stagnant lake species. On basis of the concise data given above it would be more likely to consider *P. mauricii* as a species typical

Table 3

Species composition of the accompanying macrofauna at the sampling locations of *Dicrotendipes pallidicornis*.

	Doolman 6–4–1978	Doolman 11–7–1978	Poelbos 15–3–1978
Plea leachi McGreg. & Kirk		×	
Callicorixa concinna (Fieber)	×	×	×
Callicorixa praeusta (Fieber)		×	
Sigara stagnalis (Leach)	×	×	×
Sigara lateralis (Leach)	×	×	×
Sigara striata (L.)	×	×	×
Corixa punctata (Illig.)			×
Haliplus lineatocollis Marsh.			×
Anacaena globulus (Payk.)		×	
Procladius choreus (Meigen)	×	×	×
Chironomus salinarius Kieff.		×	×
Chironomus halophilus Kieff.		×	×
Chironomus annularius Meig.		×	×
Chironomus plumosus (L.)			×
Glyptotendipes barbipes (Staeger)	×	×	×
Microchironomus deribae (Freeman)			×
Cricotopus ornatus (Meigen)		×	×
Limnephilus affinis Curtis			×
Ischnura elegans v. d. L.	×	×	
Electra crustulenta (Pallas)		×	
Hydrobia sp.		×	
Lymnaea palustris (Müller)		×	
Neomysis integer (Leach)	×	×	
Corophium sp.		×	
Orchestia gammarellus (Pallas)		×	
Gammarus duebeni Lilljeborg	×	×	
Gammarus zaddachi Sexton	×	×	×
Palaemonetes varians (Leach)	×	×	

for small fresh waters (Kleingewässer). *P. mauricii* is mostly found in the northern-German lowlands and their offshoots. Regarding the finds of Kruseman in May and September, of van Vierssen in August and of Shilova by the end of May and July, the species can at least be considered bivoltine.

Table 4

Species composition of the accompanying macrofauna at the sampling location of *Parachironomus mauricii*

Coleoptera	Heteroptera	Mollusca
dominant	*Sigara striata* (Fieb.)	*Lymnaea peregra* (Müller)
Hygrotus inaequalis (Fabr.)	*Sigara stagnalis* (Leach)	*Lymnaea palustris* (Müller)
Laccobius minutus (L.)	*Sigara falleni* (Fieb.)	*Lymnaea stagnalis* (L.)
frequent	*Corixa punctata* (Ill.)	*Planorbis planorbis* (L.)
Haliplus lineatocollis Marsh.	*Corixa affinis* Leach	*Planorbis corneus* (L.)
Haliplus immaculatus Gerh.	*Corixa panzeri* (Fieb.)	*Bithynia tentaculata* (L.)
scarce	*Hesperocorixa linnei* (Fieb.)	*Physa fontinalis* (L.)
Laccophilus hyalinus (Deg.)	*Gerris thoracicus* Schumm.	
	Notonecta glauca L.	

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Die Gattung Kloosia Kruseman, 1933 mit der Neubeschreibung zweier Arten

(Diptera, Chironomidae)

Von **Friedrich Reiss**

Abstract

Through the description of *Kloosia africana* spec. nov. (♂ imago and pupa) from Kenya, *Kloosia koreana* spec. nov. (♂ imago) from North Korea and additional unassociated exuviae of a probable new species from southwest China, the previous Holarctic distribution of the genus *Kloosia* is extended south to tropical Africa and to the Oriental Region. The collection of ♂ pupae allows positive association between imagines and pupal exuviae and indirect association with larvae. New synonymies and records presented herein document that *Kloosia pusilla* (Linné) is a member of the sand-bottom fauna of large rivers. Larvae of other congeners quite likely occur in the same habitat.

Einleitung

Seit ihrer Beschreibung stellte die monotypische und kaum zitierte Chironomini-Gattung *Kloosia* Kruseman, 1933, von der nur ♂ Imagines bekannt waren, ein recht fragliches Taxon mit ungeklärten Verwandtschaftsbeziehungen dar. Erst in allerjüngster Zeit konnte Saether (1986, 1987) durch die Synonymisierung von *Kloosia* mit der ebenfalls monotypischen, nearktischen Gattung *Oschia* Saether, 1983 belegen, daß *Kloosia* einerseits dem *Harnischia*-Gattungskomplex angehört und andererseits mit nunmehr 2 Arten holarktisch verbreitet ist.

Eine weitere offene Frage waren die unbekannten Jugendstadien von *Kloosia* und ihre ökologischen Bindungen. Den ersten Hinweis hierzu gab kürzlich Klink (1985) mit der Vermutung, daß *K. pusilla* eine potamale Art mit einer von Pagast (1936) beschriebenen Larve und Puppe sei.

Im Verlauf der vorliegenden Untersuchungen erwiesen sich die vermuteten und morphologisch auffälligen Jugendstadien von *K. pusilla* als mehrfach beschrieben und konnten durch ♂ Puppen der Art sicher zugeordnet werden. Das dabei gewonnene Gattungskonzept für ♂ Imagines und Puppen erlaubte es zudem, unbeschriebene Taxa fraglicher Gattungszugehörigkeit aus den Beständen der Zoologischen Staatssammlung München der Gattung *Kloosia* zuzuordnen.

Herrn Prof. O. A. Saether, Bergen, danke ich für die Einsicht in das zitierte unveröffentlichte Manuskript, Herrn Dr. H. Laville, Toulouse, für die Bereitstellung ♂ Puppen von *Kloosia pusilla*.

Kloosia Kruseman, 1933

Differentialdiagnose

Imago ♂:

Untere Volsella des Hypopygs nicht verkürzt, schmal und schlank, das Distalende der Analspitze erreichend oder dieses weit überragend. Bei allen anderen Gattungen des *Harnischia*-Komplexes fehlt

die untere Volsella völlig oder ist unterschiedlich stark verkürzt und endet weit vor dem Distalende der Analspitze. Von den anderen Chironomini-Gattungen unterscheidet sich *Kloosia* durch das völlige Fehlen von Makrosetae auf der unteren Volsella.

Puppe:

Die posteriore Hakenreihe auf Tergit II ist median um etwa die Länge einer Hälfte unterbrochen. Eine solch weit unterbrochene Hakenreihe besitzen unter den Chironomini nur noch die Gattungen *Chernovskiia* Saether und *Beckidia* Saether (vgl. Pinder & Reiss 1986, Tafel 10.4 und 10.5). Von diesen unterscheiden sich *Kloosia*-Puppen durch je eine anteriore und posteriore, zum Teil unterbrochene Querreihe langer heller Dornen auf den Abdominalsterniten I–III. Außerdem hat *Kloosia* ein schmales posteriomedianes Feld dicht stehender, grober, kurzer oder langer Spitzen auf Tergit VI, an das sich oralwärts ein breiter werdendes Feld zerstreut stehender Kurzspitzen anschließt, so daß ein Chagrinfeld in der Form eines umgekehrten Dreiecks entsteht. Die beiden anderen Gattungen haben ein rechteckiges Chagrinfeld, das sich analwärts nicht verjüngt. Außerdem können bei *Kloosia* auf den Tergiten II–V auffällig kammartige, posteriore Querbänder mit sehr langen Spitzen auftreten. *Beckidia*-Puppen sind zudem einfach an den gut entwickelten Pedes spurii B der Segmente II, die dicht mit kurzen Dornen besetzt sind, zu erkennen. Bedornte Pedes spurii B kommen bei keiner anderen Chironomini-Gattung vor. Hinzu kommt, daß bei *Chernovskiia* am Cephalothorax sowohl die Frontal- als auch die Dorsocentralborsten fehlen, die bei den beiden anderen Gattungen vorhanden sind.

Weitere geringe, differentialdiagnostisch fragliche Unterschiede finden sich bei den drei genannten Gattungen in der Zahl der lateralen Setae an den Abdominalsegmenten II–IV, in der Chagrinierung der Tergite I, VII und VIII sowie im Auftreten der dorsalen Setae der Schwimmplatte.

Larve:

Da kein Material zur Untersuchung verfügbar war, wird auf Saether (1987) verwiesen.

Kloosia koreana spec. nov.

Chironomini gen. K 1 (Reiss 1980: 147, 149)

Imago ♂:

Größe: Sehr kleine Art, Flügellänge 1,1–1,2 mm.

Färbung: Körper durch Alkoholfixierung ausgebleicht, gelbbraun. Thoraxfärbung nicht klar zu erkennen, vermutlich Vittae und Postnotum rotbraun. Tarsenglieder 2–5 aller Beinpaare vermutlich angedunkelt.

Antenne: Mit 11 Flagellomeren. AR = 1,25–1,34.

Kopf: Augen dorsal kräftig stegartig verlängert. Mit 8–10 Clypeusborsten und 8–9 Vertexborsten. Stirnzapfen fehlen. Länge der Palpenglieder 2–5 in μm (Holotypus): 30, 68, 98, 130.

Thorax: Mit 3–4 Acrostichal-, 6 Dorsocentral-, 3 Praealar- und 4 Scutellumborsten.

Flügel: Alle Adern, mit Ausnahme von 2 proximalen Setae auf R, nackt. Squama ebenfalls nackt.

Beine: Länge der Glieder in μm (Holotypus):

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5
P_I	430	350	480	235	180	115	70
P_{II}	410	360	175	90	75	50	40
P_{III}	420	470	260	145	125	85	60

LR = 1,37–1,42. Kämme der Mittel- und Hintertibien schmal getrennt und mit je 1 Sporn. Pulvillen fast so lang wie die Klauen.

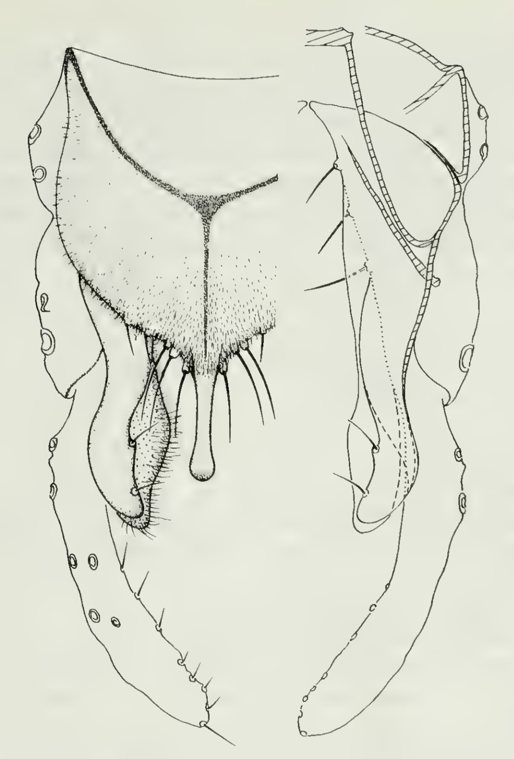


Abb. 1: *Kloosia koreana* spec. nov., Hypopyg dorsal.

Hypopyg (Abb. 1): Analtergitbänder verschmolzen, Y-förmig, medianer Ast die Basis der Analspitze erreichend. Mediane Analtergitborsten fehlen, apikale Analtergitborsten lang, lateralwärts kürzer werdend. Analspitze mittellang, schlank, distal verbreitert und stumpf gerundet; nur schwach ventralwärts gekrümmt. Obere Volsella schlank, lang, schwach S-förmig gebogen und die Analspitze deutlich überragend; nackt bis auf 2 mediane, weit auseinanderstehende und oralwärts weisende Setae. Untere Volsella schlank, gerade, subapikal leicht verbreitert und die Analspitze ebenfalls deutlich überragend; dicht mit auffallend langen Mikrotrichien bestanden, Makrosetae fehlen vollständig. Obere und untere Volsella etwa auf gleicher Höhe endend. Gonostylus schlank, lang, medianwärts gekrümmt und distal nicht verdickt; Innenkontur mit 8–9 zarten, geraden Setae besetzt.

Imago ♀, Puppe und Larve: Unbekannt.

Material: Holotypus 1 ♂ Imago, Nordkorea, Provinz South Pyongan, Pyongyan, Pyongyan-Hotel-Garten, Malaise-Falle, 2.9.1971, leg. S. Horvatovich & J. Papp (Probennummer 234 in Papp & Horvatovich 1972); das Euparal-Dauerpräparat befindet sich im Ungarischen Naturwissenschaftlichen Museum Budapest. Paratypen derselben Herkunft befinden sich, teils als Dauerpräparate, teils alkoholkonserviert, im Museum Budapest und in der Zoologischen Staatssammlung München: 4.–5.8. (Probennummer 142), 7.–8.8. (150), 9.–10.8. (156) und 31.8.1971 (225).

Differentialdiagnose

Die neue Art *Kloosia koreana* unterscheidet sich von den anderen Gattungsvertretern durch Hypopygmerkmale: Obere und untere Volsella etwa gleich lang, die Analspitze deutlich überragend; obere Volsella auf der Innenkontur mit 2 weit auseinander stehenden, oralwärts gerichteten Setae. Die anderen Arten haben unterschiedlich lange Volsellae, die obere Volsella ist anders geformt, ihre beiden medianen Setae stehen eng zusammen und zumindest eine davon ist nicht oralwärts gerichtet.

Verbreitung und Ökologie

Kloosia koreana ist bisher nur vom locus typicus bekannt geworden. Die vorliegenden relativ zahlreichen ♂ Imagines verteilen sich über die gesamte Aufenthaltszeit der 2. Ungarischen Nordkorea-Expedition am Fundort, die von Anfang August bis Mitte September reichte. Demnach ist anzunehmen, daß die Art eine lange, diesen Zeitraum überschreitende Flugzeit besitzt. Das gleichzeitige Auftreten von potamalen Arten, wie *Rheopelopia ornata* (Meigen) und *Robackia pilicauda* Saether in den Proben macht es wahrscheinlich, daß auch die Jugendstadien von *K. koreana* im nahegelegenen Fluß Te-dong siedeln, was der allgemeinen ökologischen Charakterisierung der Gattung *Kloosia* als potamales Faunenelement entsprechen würde.

Kloosia africana spec. nov.

Imago ♂:

Größe: Sehr kleine Art, geschätzte Flügellänge 1,1 mm (nach Vergleich mit der pupalen Flügelscheidenlänge von *K. pusilla).*

Färbung: Körper in alkoholfixiertem Zustand bei schlüpfreifer Imago gelbbraun, Scutum mit scharf getrennten braunen Vittae, braunem Postnotum und Praeepisternum. Scapus ebenfalls braun. Beine ohne erkennbare Farbmuster.

Antenne: Mit 11 Flagellomeren. AR = 1,05.

Kopf: Augen dorsal kräftig stegartig verlängert. Mit 10 Clypeusborsten und ca. 5 Vertexborsten. Stirnzapfen fehlen. Länge der Palpenglieder 2–5 in μm: 20, 57, 71, 93.

Thorax: Mit 6 Acrostichal-, 7 Dorsocentral-, 3 Praealar- und 6 Scutellumborsten.

Flügel: Nicht entfaltet.

Beine: Länge der Glieder in μm (in den pupalen Beinscheiden):

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5
P_I	300	265	325	150	140	100	75
P_{II}	~310	290	150	75	60	40	40
P_{III}	~350	370	~190	120	~90	65	65

LR = 1,23. Kämme der Mittel- und Hintertibien schmal getrennt und mit je 1 Sporn. Pulvillen lappenförmig, etwa 2/3 so lang wie die Klauen.

Hypopyg (Abb. 2): Analtergitbänder kurz, weit getrennt. Zwei mediane lange Analtergitborsten, die nicht deutlich von den etwa ebenso langen 13 apikalen Analtergitborsten getrennt sind. Analspitze fast paralellseitig, mittellang, distal stumpf gerundet und nur schwach ventralwärts gekrümmt. Obere Volsella nackt bis auf 2 apikale Setae, schlank, Distalhälfte medianwärts geknickt und damit im Umriß golfschlägerförmig. Die Analspitze überragt die obere Volsella. Untere Volsella ebenfalls schlank, leicht einwärts gekrümmt und dicht mit auffallend langen Mikrotrichien bestanden; Makrosetae fehlen gänzlich. Analspitze auf gleicher Höhe mit unterer Volsella endend. Gonostylus schlank, lang, medianwärts gekrümmt und distal deutlich keulenförmig verdickt; Innenkontur mit 9 zarten, geraden Setae.

Imago ♀: Unbekannt.

Puppe:

Größe: Sehr klein, Länge 2,8–4,0 mm (n = 6).

Färbung: Cephalothorax und Abdominalsegmente I–V blaßbraun, restliches Abdomen farblos.

Cephalothorax (Abb. 3c): Oralhörnchen flach gerundet, apikal mit einem kurzen spitzen Dorn. Frontalborsten zart, einfach und mittellang. Frontalwarzen fehlen. Thorakalhorn büschelförmig, Einzeläste glatt. Basalring oval, mit 1 Tracheenast. Thorax dorsal kräftig granuliert, Höhe und Zahl

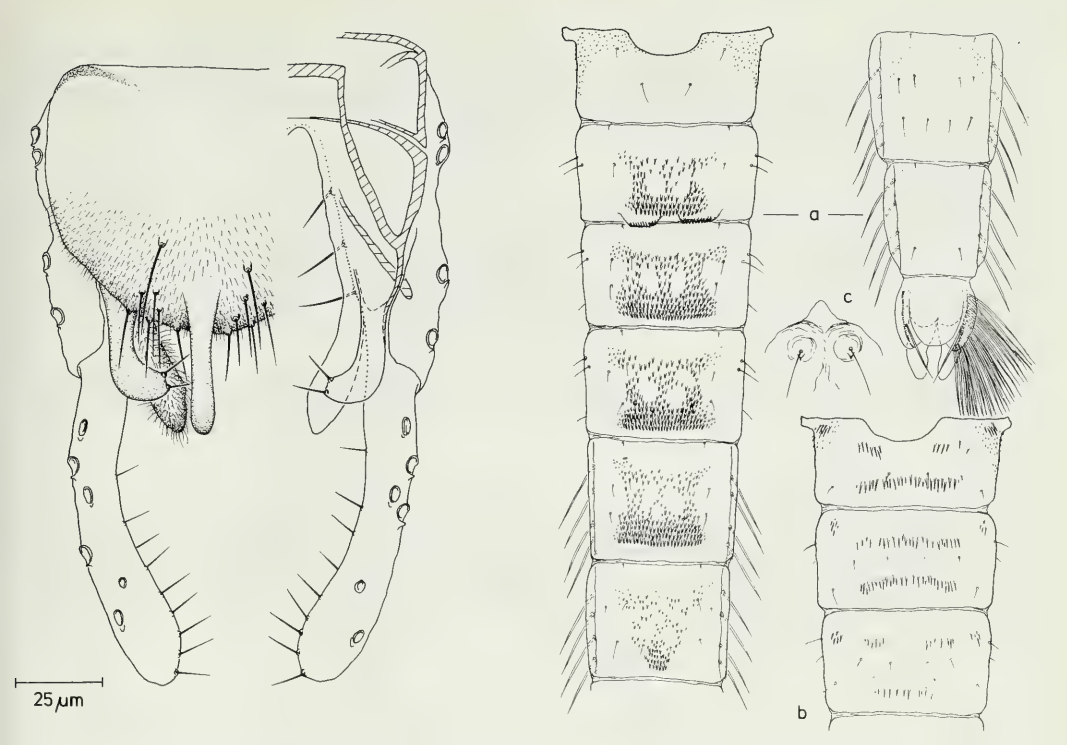


Abb. 2 links: *Kloosia africana* spec. nov., Hypopyg dorsal. 3 (rechts): Puppe. a) Abdominaltergite I–VIII; b) Abdominalsternite I–III; c) Frontalplatte.

der Granula anal- und ventralwärts abnehmend. Ein flach gerundeter, länglicher praealarer Tuberkel vorhanden. Scutumtuberkel fehlt. 2 schlauchförmige, sehr lange Antepronotal- und 2 Humeralborsten sowie 4 einfache, kürzere, paarig stehende Dorsocentralborsten.

Abdomen (Abb. 3a, b): Tergit I mit anteriolateralen Feinchagrinfeldern, II–V mit einem posterioren, transversalen, mehrreihigen Band kurzer kräftiger, etwa gleich großer Spitzen; oralwärts schließt sich ein Feld locker stehender Spitzen gleicher Größe an, das durch spitzenfreie Flecken unterbrochen ist. Tergit VI mit der prinzipiell gleichen Spitzenanordnung, jedoch ist das posteriore Band stark verkürzt. VII und VIII mit anteriolateralen Feinchagrinflecken. Schwimmplatte mit einem anteriolateralen schmalen Streifen Feinchagrin. Posteriolaterale Ecken der Tergite V und VI mit einem Fleck sehr feiner Spitzchen.

Sternite I–III mit je einer anterioren und posterioren transversalen Reihe heller, mäßig langer Spitzen; anteriore Reihe auf I und III median unterbrochen. Außerdem tragen die Sternite I–III einen zusätzlichen Langspitzenfleck in den anterioren Ecken. Sternite IV–VI chagrinfrei, VII–VIII mit 2 anterioren Feinchagrinflecken.

Posteriore Hakenreihe auf Tergit II median um etwa die Länge einer Hälfte unterbrochen; jede Hälfte mit 11–17 Haken. Konjunktive nackt. Pedes spurii A vorhanden, Pedes spurii B fehlen. Segment VIII ohne Kämme oder Sporne.

Segment I ohne L-Borsten, II–IV jederseits mit 3 kurzen L-Borsten, V-VIII mit 4 LS-Borsten. Analloben jederseits mit 1 langen dorsalen Schlauchborste. Schwimmhaarsaum aus 24–29 einzeilig stehenden Schlauchborsten bestehend. ♂ Gonopodenscheiden die Analloben mit der Hälfte ihrer Länge weit überragend. ♀ Gonopodenscheiden entsprechend kurz, apikal mit einem kleinen warzenförmigen Fortsatz.

Larve: Unbekannt.

Material: Holotypus 1 schlüpfreife ♂ Puppe, Kenia, Meru National Park, Rojewero-Flußdrift, 900 m Höhe, März 1983, leg. E. J. Fittkau. Paratypen 5 Exuvien von derselben Lokalität. Die Typenserie befindet sich als Euparal-Dauerpräparate in der Zoologischen Staatssammlung München.

Differentialdiagnose

Die ♂ Imago von *Kloosia africana* unterscheidet sich von den anderen Gattungsvertretern durch Hypopygmerkmale: Obere und untere Volsella überragen die Analspitze nicht; obere Volsella kürzer als die untere Volsella, golfschlägerförmig medianwärts gebogen, die beiden apikalen Setae eng zusammenstehend. Die beiden anderen Arten haben lange, die Analspitze weit überragende untere Volsellae, die oberen Volsellae sind nicht golfschlägerförmig und mindestens so lang oder länger als die Analspitze.

Die Puppe von *Kloosia africana* ist durch posteriore Kurzspitzenbänder der Abdominaltergite II–VI gekennzeichnet. *Kloosia pusilla* und *Kloosia* sp. tragen dort ein Querband langer bis sehr langer Spitzen.

Verbreitung und Ökologie

Kloosia africana ist nur vom locus typicus, einem Flüßchen in Nordkenia bekannt. Das Fließgewässer ist an der Fundstelle etwa 5 m breit, 0,7 m tief, rasch strömend und kommt von den 2500 m hohen Nyambeni Hills. Das Bett bestand überwiegend aus Sand mit gelegentlichen Kiesbeimengungen. In Anlehnung an die Fließgewässerzonierung gemäßigter Breiten kann die Probestelle mit Einschränkung dem oberen Potamal zugeordnet werden.

Kloosia pusilla (Linné, 1767)

Tipula pusilla Linné 1767: 975
nec *Chironomus pusillus* Lundström 1910: 13
nec *Chironomus pusillus* Lundström & Frey 1916: 8
Kloosia pusilla Kruseman 1933: 152–154
Cryptochironomus sp. Pagast 1936: 273–275
? *Kloosia pusilla* Soot-Ryen 1943: 16
Cryptochironomus sp. (Pagast) Chernovski 1949: 52
Cryptochironomus lv. *vytshegdae* sp. n. Zvereva 1950: 271–272. Nov. syn.
Cryptochironomus serpancus sp. n. Kirpichenko 1961: 780. Nov. syn.
Cryptochironomus vytshegdae Pankratova 1964: 192–196
Kloosia pusilla Albu 1980: 173–174
Cryptochironomus vytshegdae Srokosz 1980: 199; table III
Cryptochironomus vytshegdae Pankratova 1983: 166–168
Cryptochironomus sp. Pagast Rossaro 1984: 131
Cryptochironomus sp. Pagast Klink 1985: 2–3
Chironomini Genus E Pinder & Reiss 1986: 364

Taxonomische Bemerkungen

Die Typusart der Gattung, *K. pusilla,* war bisher nur als ♂ Imago bekannt, bis Klink (1985) wahrscheinlich machen konnte, daß die unter *Cryptochironomus* sp. (Pagast 1936) schon seit langem beschriebene Larve und Puppe dieser Art zugehören. Durch den aktuellen Fund ♂ Puppen in Nordafrika (Dr. H. Laville, unveröffentlicht) hat sich die Vermutung Klink's voll bestätigt. Ein Vergleich des nordafrikanischen Materials mit Exuvien aus Griechenland und der Puppenbeschreibung bei Pankratova (1964, 1983) lassen keinen Zweifel, daß auch *Cryptochironomus vytshegdae* – und damit auch *Cryptochironomus serpancus* – jüngere Synonyme von *Kloosia pusilla* sind. Das Chironomini Genus E bei Pinder & Reiss 1986 ist ebenfalls identisch mit *K. pusilla.*

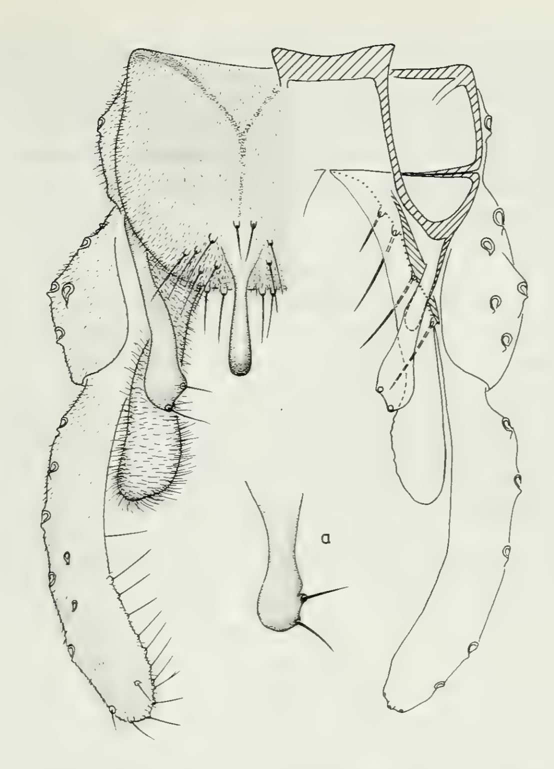


Abb. 4: *Kloosia pusilla* (Linné). Hypopyg dorsal. a) Obere Volsella, Variation.

Differentialdiagnose

Die ♂ Imagines von *Kloosia pusilla* lassen sich nach Hypopygmerkmalen (Abb. 4) von *K. africana* und *K. koreana* (Form und Länge der oberen und unteren Volsellae in Relation zur Analspitzenlänge) und von der sehr ähnlichen nearktischen Art *K. dorsenna* (Saether) durch die Struktur des Tentoriums (Saether 1987) unterscheiden. Die bekannten Puppen sind artlich ebenfalls gut zu trennen (vgl. Differentialdiagnose von *Kloosia africana* sowie Tafel 10.90 bei Pinder & Reiss 1986).

Ökologie und Verbreitung

Ein Vergleich der vorliegenden Daten zeigt, daß die Larven von *Kloosia pusilla* ein potamales Faunenelement sind. Sie leben vorwiegend in Sandsedimenten größerer Flüsse, wobei die höchste durchschnittliche Larvenabundanz von Srokosz (1980) mit 938 Ind./m^2 im Unterlauf der Nida, Polen, gefunden wurde. Eine gute Habitatcharakterisierung findet sich bei Pagast (1936): „... im Flußsand mit wenig organischer Substanz bei schwacher Strömung in 1/4 m Tiefe."

Die Art ist in der Westpalaearktis auch heute noch, trotz hoher Gefährdung ihres Lebensraumes, den Flußsanden, offenbar weit verbreitet.

Funde liegen vor aus der UdSSR (Flüßchen in Livland, Oka, Pechora, Vychegda, Wolga, mittlerer Dnepr), Polen (Nida-Unterlauf), Italien (mittlerer Po), diversen Lokalitäten in Holland (Klink 1985), Rumänien (Albu 1980) und eventuell Norwegen (Soot-Ryen 1943; Nachbestimmung notwendig). Neunachweise liegen vor aus dem Fluß Axios (Vardar) O Chalkidon, Griechenland, 5.5.1983, zahlreiche Exuvien aus Oberflächendrift, leg. M. Baehr sowie aus dem Aras-Tal W Karakurt, Provinz Hakkari, Osttürkei, 1300 m Höhe, 4.7.1985, 2 ♂♂ Imagines, leg. W. Schacht. Das Material befindet sich in der Zoologischen Staatssammlung München. Außerdem sind ♂ Puppen und Exuvien aus Tunesien bekannt (Coll. H. Laville, Toulouse; det. F. Reiss): Fluß Medjerda bei Jendouba, 146 m NN,

1 Exuvie, 12.4.1985, max. Wassertemperatur 24° C; Bourheurtma, linker Zufluß des Medjerda, 133 m NN, 2 Exuvien, max. Wassertemperatur 23° C; Oase Tozeur, Thermalquelle in einem Palmenhain, 3 ♂ Puppen aus Sandboden sowie 2 Exuvien, 10.4.1985, Wassertemperatur 30,5° C; Oase Nefta, Thermalquelle in einem Palmenhain, sandig-kiesiges Substrat, 1 Exuvie, 10.4.1985, Wassertemperatur 28,3° C.

Die finnischen Funde von *Kloosia pusilla*, zitiert bei LUNDSTRÖM 1910 und LUNDSTRÖM & FREY 1916 sind Fehlbestimmungen, wie die kürzliche Durchsicht des kompletten Originalmaterials aus dem Zoologischen Museum Helsinki durch den Autor ergeben hat.

Kloosia dorsenna (Saether, 1983)

Oschia dorsenna SAETHER 1983

Von dieser nearktischen Art aus South Carolina, USA, sind derzeit nur ♂ Imagines bekannt. Sie sind *Kloosia pusilla* sehr ähnlich. Unterschiede finden sich in der Tentorium-Struktur und in 1–2 zarten Setae an der Squama, im Kontrast zur ausnahmslos nackten Squama bei *pusilla*.

Bezüglich der *Kloosia*-Gattungsdiagnose läßt sich am untersuchten Typenmaterial von *dorsenna* ergänzend feststellen, daß die obere Volsella, wie bei allen anderen Gattungsvertretern, keine Mikrotrichien trägt und daß das Analtergit median getrennte Analtergitbänder besitzt. In der Originalbeschreibung muß die Abb. 1 c entsprechend korrigiert werden.

Kloosia sp.

Puppe:

Entspricht in Größe (Länge 3,0–3,4 mm), Färbung und Chaetotaxie (Analflosse mit 23–26 Setae) weitgehend der Art *pusilla*. Ein Unterschied besteht in der Länge der posterioren Nadelspitzen auf den Abdominaltergiten II–V. Sie sind bei *Kloosia* sp. merklich länger als bei *K. pusilla*. Eine spezifische oder subspezifische Wertung dieses Merkmals kann ohne zugehörige Imago nicht erfolgen.

Verbreitung und Ökologie

Der vorliegende Fund aus Südwestchina ist der erste Nachweis der Gattung *Kloosia* aus der Orientalis: Prov. Yünnan, 7 km O Mung Lun, Schutzgebiet Tri Ping Fung, Flußdrift, 28.5.1980, leg. E. J. Fittkau. Der Fluß, ein Zufluß des Mekong, ist an der Fundstelle und am Ende der Trockenzeit ca. 50–70 m breit und weist vorwiegend grobkiesigen Untergrund auf. Das mit 3 Individuen ausgesprochen seltene Auftreten von *Kloosia* sp. in einer sonst sehr arten- und individuenreichen Driftprobe läßt sich wohl mit dem Mangel an Sandsedimenten als geeignetes Larvenhabitat erklären. Soweit überhaupt bestimmbar, enthielt die Probe an weiteren potamalen Faunenelementen Exuvien von *Robackia* sp., *Sublettea* sp. und von Chironomini Genus D (PINDER & REISS 1986), einem in anderem Zusammenhang zu behandelnden Taxon.

Diskussion

In zunehmendem Maße erweist sich ein beträchtlicher Teil der Arten des *Harnischia*-Gattungskomplexes weltweit als bedeutende Komponente der Chironomidenfauna großer Fließgewässer. Aufgeführt sei in diesem Zusammenhang die Zusammensetzung der Chironomidenfauna einer kleinen Oberflächendriftprobe aus dem griechischen Fluß Axios östlich Chalkidon vom 5.5.1983 (leg. M. Baehr). An der Probestelle wies der Fluß etwa 150 m Breite, 2 m Tiefe, Sand- und Schlickbänke bei kräftiger Strömung auf. Von den insgesamt 162 Exuvien gehörten 48 (29,6 %), von den 19 Arten 6 (31,6 %) zum *Harnischia*-Komplex, wobei *Kloosia pusilla* mit 30 Individuen dominant war.

Ein hoher Anteil dieser potamalen Komponente innerhalb des *Harnischia*-Komplexes ist auf Art- und Gattungsniveau taxonomisch nicht oder erst in jüngster Zeit erfaßt worden. Eines der Beispiele dafür ist die Gattung *Kloosia,* die – bis vor kurzem nur mit einer ökologisch bezugslosen europäischen Art vertreten – nunmehr mindestens 4 Arten in 3 zoogeographischen Regionen, der Holarktis, Afrotropis und Orientalis, aufzuweisen hat. Zudem darf man annehmen, daß damit noch nicht das gesamte Arteninventar dokumentiert ist.

Einer der Gründe für das späte Erkennen und verzögerte Erfassen dieses potamalen Faunenanteils bei Chironomiden ist in methodischen Schwierigkeiten zu suchen, die eine faunistisch-biologische, vor allem aber ökologisch-quantifizierende Bearbeitung von Fluß- und Stromzoozönosen mit sich bringt. Große, physikalisch und biologisch extrem dynamische Fließgewässer lassen sich ungleich schwieriger bewältigen als die relativ statischen stehenden Gewässer aller Größenklassen. Hinzu kommt die vergleichsweise frühzeitige, zivilisatorisch bedingte Degradierung und Kontaminierung der meisten großen Fließgewässer gemäßigter Breiten, die die Untersuchung ihrer naturnahen Fauna in den vergangenen Jahrzehnten nicht mehr zuließen. Jedoch zeigt gerade die Erfahrung der letzten Jahre, daß viele in Europa als erloschen gegoltene Potamobionte lokal in Klein- und Kleinstpopulationen offensichtlich überlebt haben und damit, wenn auch nicht dem Ökologen, so doch dem Taxonomen zur Bearbeitung verfügbar blieben.

Bei den Chironomiden finden sich potamobionte Arten des *Harnischia*-Komplexes vor allem in den Gattungen *Acalcarella, Beckidia, Chernovskiia, Cyphomella, Gillotia, Kloosia, Robackia, Saetheria* und Chironomini Genus D. Hinzu kommen zahlreiche Arten ungeklärter Gattungszugehörigkeit, von denen zum Teil nur das Larvenstadium beschrieben ist. Etwa ein Dutzend davon ist unter *Cryptochironomus* bei Pankratova (1983) zu finden. Mindestens dieselbe Zahl noch unbeschriebener Larventypen unbekannter Gattungszugehörigkeit sind mir aus dem Stromsystem des Amazonasbeckens bekannt. Hinzu kommen weitere, offenbar an größere Fließgewässer gebundene und ebenfalls unbeschriebene Taxa aus Nordafrika, dem tropischen Afrika, Madagaskar, Nordindien, Südwestchina und Neukaledonien.

Global gesehen, entsteht bei der Betrachtung der potamalen Komponente des *Harnischia*-Komplexes zunehmend der Eindruck einer generisch ausnehmend stark differenzierten und phylogenetisch alten Entwicklungslinie, die ihre Anpassung an einen archaischen aquatischen Lebensraum durch zahlreiche Apomorphien, speziell bei Larven, dokumentiert.

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Diplosmittia recisus spec. nov. from Peru

(Diptera, Chironomidae)

By Ole A. Sæther

Abstract

The male of *Diplosmittia recisus* spec. nov. is described from Peru. It differs from *D. harrisoni* Sæther from the Eastern Lesser Antillean Islands, and *D. carinata* Sæther from Michigan, the two previously known members of the genus, in having only 9 flagellomeres and a strongly extended costa.

Introduction

Sæther (1981) described four new genera from the British West Indies. Three of these genera later were described also from the southeastern parts of the U.S.A. (Sæther 1982). The remaining genus, *Diplosmittia*, recently was described from Michigan (Sæther 1985). Recently Dr. F. Reiss, Zoologische Staatssammlung, Munich, sent me a male imago collected in Peru. It proved to belong to a new species of *Diplosmittia* closely related to the previously described species.

Methods and morphology

The general terminology follows Sæther (1980) with the exception that the apical spine of the gonostylus is termed the megaseta. In the figure of the male hypopygium the dorsal aspect is shown to the left, the ventral aspect and the apodemes to the right.

Diplosmittia Sæther, 1981: 29, emended

Antenna with 9–13 flagellomeres, flagellomeres 2–8 or possibly sometimes only 2–5, and ultimate with sensilla chaetica. Costa not or barely to relatively strongly extended, with or without additional false vein extending beyond costa nearly to wing tip. Otherwise as in Sæther (1981: 29).

Diplosmittia recisus spec. nov.
(Fig. 1)

Type material: Holotype, male, Station Koepke Panguana, about 260 m a. s. l., 9°37′S, 74°56′W, Peru, 17.2.1974, W. Kurz (Nr. 10), in the collection of Zoologische Staatssammlung, Munich.

Diagnostic characters

Nine flagellomeres, costal extension moderately long (about 68 μm), LR_1 0.36, LR_2 0.36, LR_3 0.43.

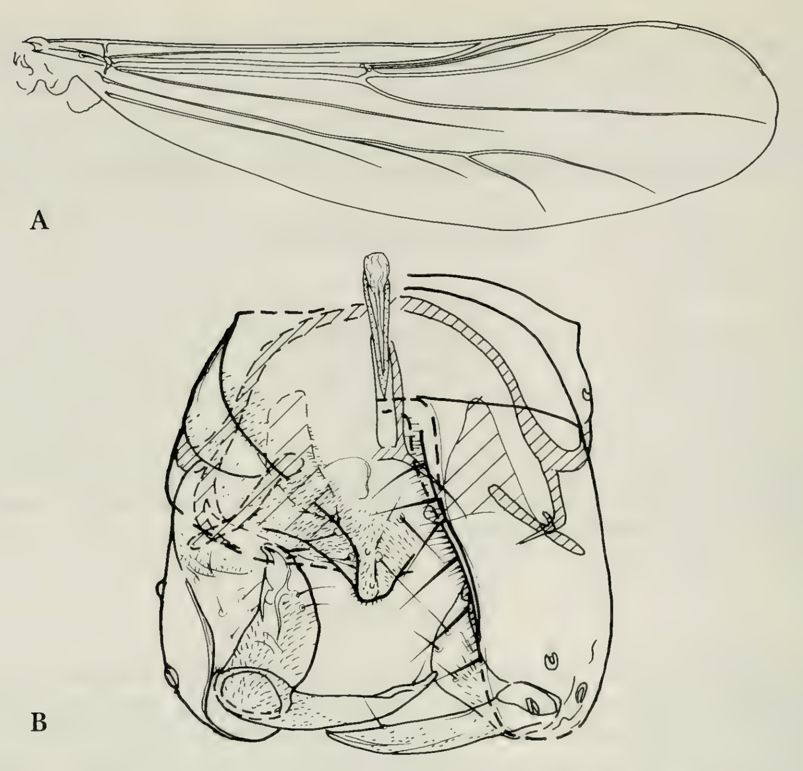


Fig. 1. *Diplosmittia recisus* spec. nov., male imago. — A. Wing. — B. Hypopygium.

Etymology: From Latin, *recisus,* cut back, cut short, referring to the reduced number of flagellomeres.

Description

Male imago (n = 1)

Total length 1.33 mm. Wing length 0.79 mm. Total length/wing length 1.68. Wing length/length of profemur 2.98. Coloration brown.

Head (as in *D. harrisoni,* SÆTHER 1981 fig. 13 A). Nine flagellomeres, ultimate 244 μm long. AR 0.80. Temporal setae apparently consisting of 1 inner vertical. Clypeus apparently with 4 setae. Tentorium and stipes not measurable. Palp segments length (micrometers): 15, 19, 41, 45, 45.

Thorax (as in *D. harrisoni,* SÆTHER 1981 fig. 13 B). Antepronotum apparently with 1 lateral seta only. Dorsocentrals 4, prealars 3. Scutellum with 2 setae.

Wing (Fig. 1 A). VR 1.44. C extension 68 μm long. Brachiolum with 1 seta.

Legs. Spur of front tibia 26 μm long, spurs of middle tibia 15 μm and 11 μm long, of hind tibia 32 μm and 15 μm long. Width at apex of front tibia 26 μm, of middle tibia 23 μm, of hind tibia 23 μm. Comb with 8 setae, 17–23 μm long. Lengths (micrometers) and proportions of legs:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
P_1	266	341	124	79	56	30	30	o.36	3.75	4.91	2.3
P_2	323	356	129	79	58	30	32	0.36	4.07	5.25	2.7
P_3	293	328	143	90	94	24	30	0.43	3.08	4.36	3.3

Hypopygium (Fig. 1B). Anal point with 6 lateral and basal setae, laterosternite IX with 2 setae. Phallapodeme 63 μm long, transverse sternapodeme 54 μm long. Virga 38 μm long. Gonocoxite 92 μm long. Gonostylus 49 μm long, with lobe 57 μm long, apical megaseta 6 μm long. HR 1.91, HV 2.72.

Acknowledgement

I am much indebted to Dr. F. Reiss, Zoologische Staatssammlung, Munich, for the type material.

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Vivacricotopus, a new genus of Orthocladiinae from Norway

(Diptera, Chironomidae)

Øyvind A. Schnell and Ole A. Sæther

Abstract

A new genus and species of Orthocladiinae, *Vivacricotopus ablusus*, is described as male imago and pupa. The imago has hairy eyes; well developed pulvilli; coarse punctation of microtrichia on wing membrane; two median acrostichals; long, bare anal point; and a virga; which is a unique combination. The pupa has thoracic horn and anal fringe, and a unique arrangement of simple, branched and broadly filamentous L-seta. The genus apparently occupies a plesiomorphic position within the *Rheocricotopus* group of genera.

Introduction

During the investigations of the area around the Jostedal Glacier in connection with the future building of hydroelectric power stations and dams, some peculiar pupal exuviae were found in the partly glacier fed river Jostedøla. Closer examination showed that also a male belonging to an unknown genus with the same affinities was present in the same sample. The new genus and species is described below.

Methods and Morphology

The mounting procedure used is outlined by SÆTHER (1969: 1). The general terminology follows SÆTHER (1980) with the exception that the vannal fold is called the postcubitus, and the apical spine of the gonostylus the megaseta. The measurements are given as ranges followed by a mean, followed by the number measured in parenthesis (n).

Vivacricotopus gen. nov.

Type species: *Vivacricotopus ablusus* spec. nov. by present designation.

Diagnostic characters

The combination of hairy eyes; large pulvilli; two central acrostichals; relatively coarse punctation on wing membrane; nearly straight Cu_1; long, narrow and bare anal point; and presence of virga will separate the male imago from all other orthoclads. The absence of antepronotals, the low number of dorsocentrals and scutellars, and the absence of a crista dorsalis also are characteristic.

The pupa has a unique pattern of shape of L-setae with L_4 split in 2–6 branches on segments III–VI; L_3 on VI filamentous; 4 filamentous L-setae on VII and 5 filamentous L-setae on VIII, with the two posterior on each segment very broad. Also the caudolateral extension of segments VII and VIII and the very strong anal macrosetae are unique features.

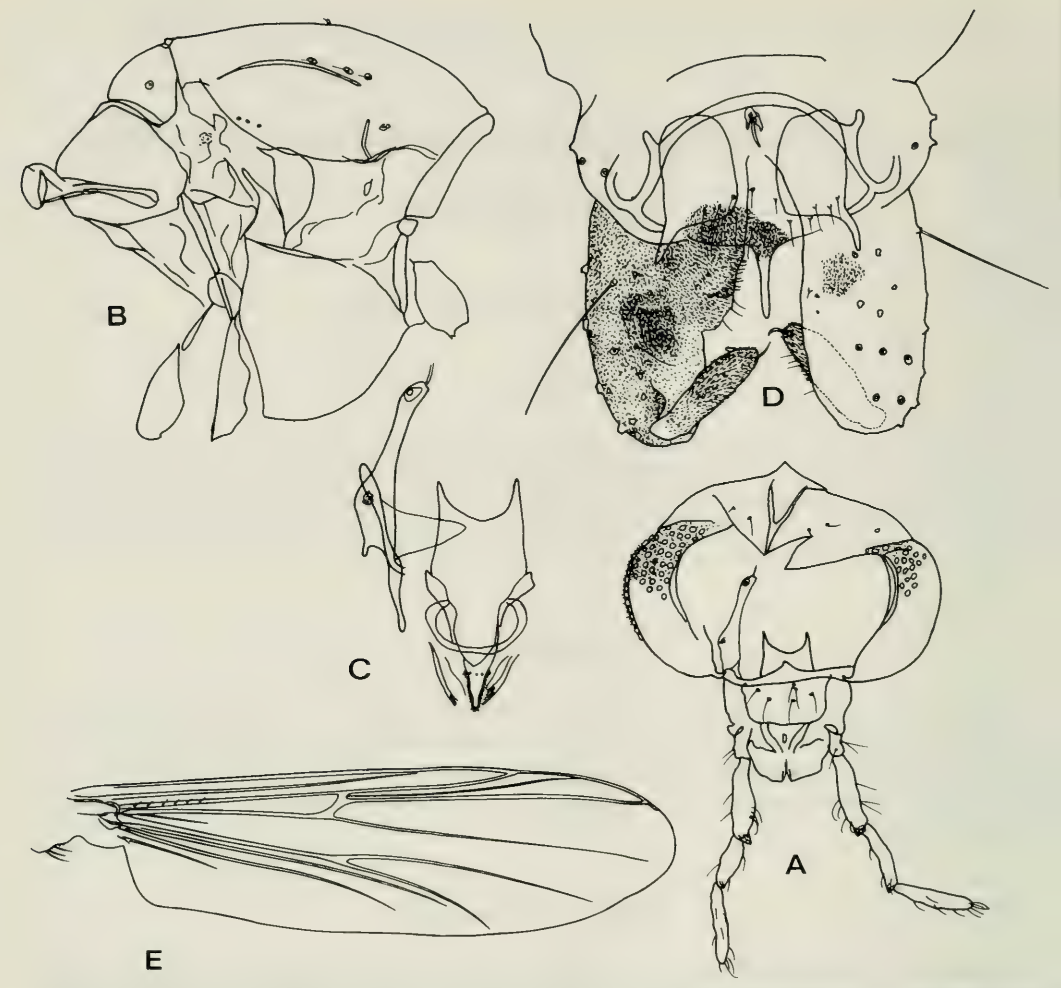


Fig. 1. *Vivacricotopus ablusus* gen. nov., spec. nov., male imago. — A. Head. — B. Thorax. — C. Cibarial pump, tentorium, and stipes. — D. Hypopygium, dorsal aspect to the left, ventral aspect to the right. — E. Wing.

Etymology: From the type locality Viva, near the river Jostedøla, and Cricotopus, a common genus name and ending among Orthocladiinae meaning ringed legs.

Description

Male imago

Medium sized species, wing length about 2 mm. Coloration brown with ringed tibia and pale tarsi.

Eyes hairy with short, wedge-shaped dorsomedial extension.

Antenna with 13 flagellomeres; antennal groove beginning at flagellomere 3; flagellomeres 2, 3, 4 and 13 with thin sensilla chaetica; AR lower than 1.0. Temporals divided into very short inner verticals, longer outer verticals and longest postorbitals.

Clypeus as wide as pedicel. Anterior margin of cibarial pump deeply concave. Five palpal segments, third and fifth subequal in length, third palpal segment with weak apical projection and apparently without apical sensilla clavata, fourth segment with indication of similar apical projection.

Antepronotum well developed; median lobes not medially narrowed, gaping, separated in front of scutal projection; no lateral setae. Two acrostichals in centre of scutum, dorsocentrals and prealars few, supraalars absent. Scutellum with few setae.

Wing membrane with relatively coarse punctation of microtrichia, free of setae. Anal lobe well developed, slightly projecting. Costa slightly extended; R_{2+3} running in the middle between R_1 and R_{4+5}, ending at 1/3 the distance between end of R_1 and R_{4+5}; R_{4+5} ends clearly distal to end of M_{3+4}; FCu lies distally of RM, Cu_1 nearly straight, postcubitus ends far distally of FCu, anal vein ends slightly distally of FCu. R with a few setae, R_1 bare, R_{4+5} with seta(e) at apex. Sensilla campaniformia in normal numbers (about 12 at base, 3 below seta and 13 at apex of brachiolum, 2 on subcosta, 1 on FR, and 1 at base of R_1). Squama with few setae in fringe.

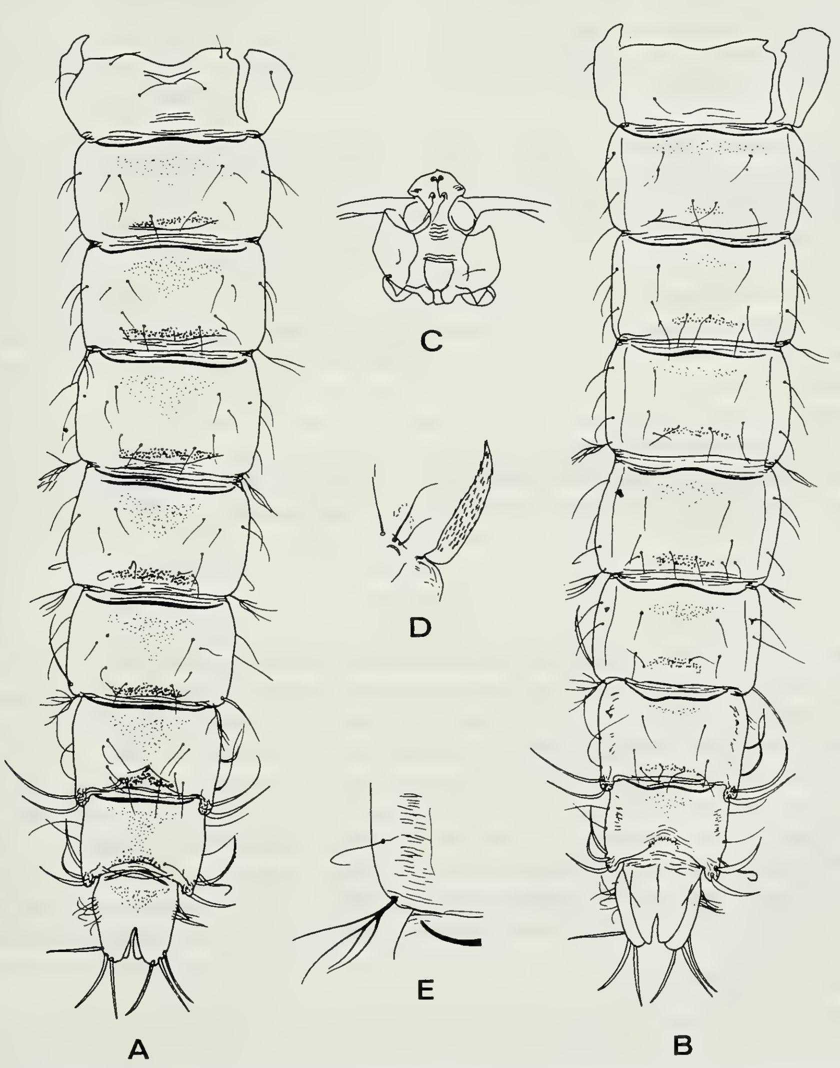


Fig. 2 *Vivacricotopus ablusus* gen. nov., spec. nov., pupa. – A. Tergites. – B. Sternites. – C. Frontal apotome and ocular field. – D. Thoracic horn and precorneal setae. – E. Caudolateral corner of segment V.

Tibial spurs and hind tibial comb normal. Tibia with pale rings. Pseudospurs absent. Sensilla chaetica present in basal 1/2 of tarsomere 1 of hind leg. Pulvilli well developed, about 3/4 as long as claws.

Tergites with setae in 2–3 rows of median setae and 2–3 rows of lateral and posterior setae, or more scattered. Anal point long, free of microtrichia, with several setae at base on tergite IX. Phallapodeme normal, transverse sternapodeme curved with well developed oral projections. Virga consisting of cluster of 2–3 spines. Gonocoxite with low inferior volsella and no superior volsella. Gonostylus evenly wide for most of its length, with well developed megaseta, without crista dorsalis.

Pupa

Median sized pupae about 4 mm long. Frontal seta moderately long, on frontal apotome. Frontal apotome with weak to moderately developed warts, slightly wrinkled. Antennal sheath at most with 2–4 pearls above pedicel. Ocular field with 2 postorbitals. Antepronotum with 2 median and 2 lateral setae, all well developed. Thoracic horn cylindrical, tapering towards apex, covered with not very dense spinules. Two anterior setae subequal in length and about twice as long as posterior seta. Second dorsocentral longer than the others, anterior 3 dorsocentrals grouped or third equidistant from second and fourth. Thorax slightly wrinkled, wing sheath nearly smooth. Sheath of coxae with 1 minute seta each.

Tergite I without shagreen, II–IX with weak anterior and narrow median shagreen grading over into caudal spines on II–VIII. Sternites I and IX without shagreen; II–VIII with weak anterior group shagreen, more extensive on posterior sternites and grading over into weak caudal spines. Tergites II–VIII with about 4 rows of weak caudal spines, weaker on VIII. Tergite II without caudal hooklets. Caudal margin of sternites II–VII with 3–4 rows of similar, but weaker caudal spines, very weak or reduced to a few spinules on II. No spinules on conjunctives. Pedes spurii A and B absent. Segment I with 4 D setae, 1 L seta and 2 V setae. Segments II–VII with 5 D setae, 4 L setae, 4 V setae, and O setae in pattern B (Coffman 1979, 2 dorsal and 1 ventral pair of O setae). Segment VIII with 1 D seta, 5 L setae and 1 V seta. L_4 on segments III–VI split into 2–6 branches, L_3 on segment VI and all L setae on VII and VIII filamentous, L_4 and L_5 very broad on segments VII and VIII. Segments VII and VIII with conspicuous, rounded, darkened caudolateral projections. Apophyses well delineated. Anal lobe with sparse fringe of lamelliform setae and 3 very strong macrosetae about 2/3 as long as the lobe with lateral macroseta slightly weaker then the median ones. Male genital sac not reaching apex of anal lobe.

Systematics

Especially the pupa but also the male imago of the new genus shows an unusual combination of characters. The hairy eyes, the large pulvilli, the median acrostichals, and the pupal horn, spine pattern and anal lobe fringe apparently place the genus in the *Rheocricotopus* Thienemann & Harnisch group of genere (Brundin 1956: 118; Sæther 1977 fig. 36, 1980b: 131, 1981: 224, 1983a fig. 5, 1985: 63). However, *Rheocricotopus, Paracricotopus* Thienemann & Harnisch, *Mesocricotopus* Brundin, *Nanocladius* Kieffer, *Doncricotopus* Sæther and *Psectrocladius* Kieffer all lacks a virga and the 5 first have a platelike superior volsella not found in *Vivacricotopus.* The male imago also resembles *Sublettiella* Sæther (1983b) in the absence of lateral antepronotals, the low thoracic chaetotaxy, the wing punctation and venation except for the somewhat less curved Cu_1, the hairy eyes, the presence of pulvilli, the virga, and the low inferior volsella. *Vivacricotopus,* however, differ from *Sublettiella* for instance in the absence of pseudospurs, the presence of sensilla chaetica on hind leg, the presence of 2 median acrostichals and the long bare anal point.

The pupa of *Vivacricotopus* will key to *Unniella* Sæther in Coffman et al. (1986). However, it does show few similarities with that genus. Among genera with anal lobe fringe and thoracic horn no other genus is at the same time lacking pedes spurii A and B and caudal hooklets on tergite II. Caudal hooklets are absent only in *Parametriocnemus* Goetghebuer and *Paratrissocladius* Zavřel, pedes spurii A

may be absent in some *Zalutschia* Lipina, while *Paracricotopus, Nanocladius* subgen. *Plecopteracoluthus* Steffan, *Zalutschia,* many *Psectrocladius,* some *Rheocricotopus,* and some *Heterotanytarsus* Spärck lack pedes spurii B. The shape of the L setae with L_4 branched and the posterior L setae on segments VII and VIII very broad is unique. The B pattern of O setae is not very common in the Orthocladiinae, but is the pattern found in *Psectrocladius, Rheocricotopus* and *Unniella.*

Although the genus most likely belong near or in the *Rheocricotopus* group it probably occupies a plesiomorphic position relative to the other genera of the group. It also show similarities with *Sublettiella* and the genera near *Bryophaenocladius* Thienemann and partly with *Unniella.* As most likely for the last genus in which the pupa appear to belong to the *Rheocricotopus* group, the larva to the *Parakiefferiella* group and the male imago to the *Mesosmittia* group, the similarities of *Vivacricotopus* with the *Rheocricotopus* group may be based on plesiomorphies. In that case a placement near *Sublettiella* is the most likely one.

Vivacricotopus ablusus spec. nov.
(Figs 1, 2)

Type locality: Norway, Sogn & Fjordane, Luster, Jostedøla river, Viva.

Type material: Holotype, male, Viva, Jostedøla river, Luster, Sogn & Fjordane, Norway, 23.VII.1986. Leg.: Ø. A. Schnell and A. Fjellheim (ZMBN No. 107). Paratypes, 6 pupal exuviae, same data as holotype. Types in coll. Mus. Zool., Ent. coll. Univ. of Bergen (ZMBN).

Diagnosis: See diagnosis of the new genus.

Etymology: From Latin *ablusus,* meaning different, unlike, referring both to the unique combination of characters and to the very different types of L-setae on the pupae.

Description

Male Imago

Total length 3.10 mm. Wing length 1.93 mm. Total length/wing length 1.61. Wing length/length of profemur 2.91. Coloration brown, halterers pale brown, tarsi and middle 2/3 of tibiae pale.

Head (Figs 1 A + 1 C). AR 0.72. Ultimate flagellomere 364 μm long. Temporal setae 7, including 3 inner verticals, 2 outer verticals, and 2 postorbitals. Clypeus with 7 setae. Cibarial pump, tentorium and stipes as in Fig. 1 C. Tentorium 150 μm long, 32 μm wide. Stipes 139 μm long, 56 μm wide. Palp segments length (micrometers): 30, 53, 120, 88, 116. Third palpal segment with weak apical projection, apparently no sensilla clavata; fourth segment with similar projection.

Thorax (Fig. 1 B). Antepronotum bare. Humeral pit weak, normal. Dorsocentrals 3, acrostichals 2, prealars 3. Scutellum with 2 setae.

Wing (Fig. 1 E). Wing membrane with punctation of microtrichia visible at 150×. C extension 45 μm long. R with 6 setae, R_1 bare, R_{4+5} with 1 apical seta, C extension with 1 non-marginal seta. Squama with 7 setae.

Legs. Spur of front tibia 49 μm long, spurs of middle tibia 24 μm and 23 μm long, of hind tibia 49 μm and 19 μm long. Width at apex of front tibia 38 μm, of middle tibia 36 μm, of hind tibia 41 μm. Comb of hind tibia with 12 setae, 19–49 μm long. Sensilla chaetica 8 at 0.19–0.49 on ta_1 of hind leg. Lengths (micrometers) and proportions of legs:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
P_1	662	775	454	326	217	132	85	0.59	2.48	3.17	2.6
P_2	695	709	312	189	142	99	80	0.44	3.37	4.52	2.6
P_3	709	832	416	241	189	104	76	0.50	3.21	3.70	3.7

Hypopygium (Fig. 1D). Anal point 41 μm long, with 14 setae at base on tergite IX; laterosternite IX with 5 setae. Phallapodeme 79 μm long, transverse sternapodeme 109 μm long. Virga 24 μm long. Gonocoxite 193 μm long, inferior volsella weak. Gonostylus 77 μm long, megaseta 19 μm long. HR 2.51, HV 4.03.

Pupa (n = 6, except when otherwise stated).

Total length 3.70–4.03, 3.88 mm. Exuviae pale brownish grey.

Cephalothorax. Frontal setae on frontal apotome (Fig. 2C), 75–116, 99 μm long. Postorbitals 75–116, 95 μm and 56–94, 70 μm long. Median antepronotals both 75–113, 96 μm long. Thoracic horn (Fig. 2D) 188–221, 209 μm long; 36–43, 40 μm wide; 1.06–1.19, 1.14 times as long as anal macrosetae. Anterior precorneal seta 79–131, 94 μm long; 4–17, 10 μm in front of median seta. Median precorneal seta 105–135, 126 μm long; 4–15, 8 μm in front of posterior seta. Posterior precorneal seta 45–86, 61 μm long; 38–45, 41 μm in front of horn. Second dorsocentral (Dc_2) 68–105, 82 μm long; other dorsocentrals 45–64, 55 μm long. Distance between Dc_1 and Dc_2 15–23, 17 μm; between Dc_2 and Dc_3 15–38, 24 μm; between Dc_3 and Dc_4 39–68, 50 μm. Setae on coxal sheaths 2–11, 6 μm long on front leg; 11–26, 20 μm long in middle leg; 23–30, 26 μm long on hind leg.

Abdomen (Fig. 2A, B). Shagreenation, caudal spines and chaetotaxy as in generic diagnosis. Maximal length (micrometers) of caudal spines on TII–VIII as: 6–9, 7; 8–11, 10; 11–15, 13; 15–17, 16; 17–23, 21; 13–21, 19; 4–8, 6. L_4 on segment III split into 2 branches; on IV and V in 3–4, 4 branches (Fig. 2E); on VI in 3–6, 4 branches. Anal lobe 263–278, 268 μm long; with 8–12, 10 setae in fringe; macrosetae 176–193, 183 μm long. Genital sac of male ending 11–23, 17 μm (5) short of apex of anal lobe; of female ending 98 μm (1) short of anal lobe.

Ecology and Distribution.

The pupal exuviae and the drowned male imago were collected in an eddy where the river Jostedøla runs into a small lake at Viva (alt. 890 m a. s. l., UTM ref. 32V MP 474184) in the uppermost part of the valley Jostedal. The type locality is situated above the timber line only a few kilometers east of the Jostedal Glacier, which is the largest glacier on mainland Europe, covering an area of approximately 486 sq. km.

The water temperature varies between near 0°C during the period of ice cover; from middle of the november to end of may; to 11.7°C the day the specimens were sampled, the highest measured at Viva in the years –85 and –86. The pH varies between 5.0 to 6.0, the conductivity (μS/cm) between 5.7 to 9.5 during –85 and –86. (A. Fjellheim pers. comm.). The river is heavily loaded with silt from the nearby glacier.

Some other chironomids found at the type locality were: *Diamesa lindrothi* Goetghebuer, *Pseudodiamesa* cf. *nivosa* (Goetghebuer), *Eukiefferiella minor* (Edwards), several new species of *Limnophyes* SÆTHER 1988, *Mesocricotopus thienemanni* (Goetghebuer), *Orthocladius (Eudactylocladius) grampianus* (Edwards), *Orthocladius (Euorthocladius) frigidus* (Zetterstedt), *Orthocladius (Euorthocladius) rivicola* Kieffer, *Orthocladius (Euorthocladius) thienemanni* Kieffer, *Psectrocladius (Allopsectrocladius)* sp., *Rheocricotopus (Rheocricotopus) effusus* (Walker), *Rheocricotopus (Rheocricotopus) reduncus* Sæther & Schnell 1988, *Micropsectra recurvata* (Goetghebuer).

The new species is known only from the type locality.

Acknowledgements

We are indebted to the Norwegian Water Resource and Electricity Board for financial support and to Arne Fjellheim at Museum of Zoology, University of Bergen, for providing us with information on the temperature and water properties of the type locality.

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Heterotrissocladius brundini spec. nov. from Norway

(Diptera, Chironomidae)

By **Ole A. Sæther** and **Øyvind A. Schnell**

Abstract

Heterotrissocladius brundini spec. nov. is described in all stages and both sexes. It apparently form the plesiomorphic sister species of *H. maeaeri* Brundin.

Introduction

Langton (1984: 88, fig. 28a) illustrated a pupa of *Heterotrissocladius* with imbedded spines on segments VI-VIII and very large frontal warts. During an investigation of some acidified lakes in the southernmost part of Norway the junior author found all stages of apparently the same species. Later it was found also in western and northwestern Norway.

Methods and morphology

Morphological nomenclature follows Sæther (1980) with the exception that the apical spine of the gonostylus is termed the megaseta. The measurements are given as ranges followed by a mean when four or more measurements are made, followed by the number measured in parentheses (n).

The type material is kept at the Museum of Zoology, University of Bergen (ZMB).

Heterotrissocladius Spärck 1922, emended

Imago – Eyes completely naked, with a few microtrichia between marginal ommatids or pubescent, i. e. with microtrichia between all ommatids, with reticulation between central ommatids. Otherwise as in Sæther (1975: 3).

Pupa – Frontal warts weak to strongly developed. Frontal setae on frontal apotome (most species) or on prefrons (at least *H. latilaminus* Sæther). Caudolateral corners of segments VI-VIII occasionally with inner sclerotization resembling imbedded spines (*H. brundini* spec. nov), these strong on VII, weaker on VI, and only indicated on VIII. Otherwise as in Sæther (1975: 4).

Larva – Anterior parapods with apical claws grading over into basal hair-like spines anteriorly and on a common base. Otherwise as in Sæther (1975: 4).

Heterotrissocladius brundini spec. nov.
(Figs 1–3)

Heterotrissocladius Pe 1, Langton 1984: 88

Type locality: Norway, Aust-Agder, Birkenes, Lake Repstadvatn.

Type material: Holotype, male, Lake Repstadvatn, Birkenes, Aust-Agder, Norway, 19/9/86, leg. H. Sægrov & Ø. A. Schnell, in coll. Mus. Zool. Univ. of Bergen (ZMB No. 115).

Paratypes: 5 males, 4 females, 2 male pupae, 147 pupal exuviae, 6 larval exuviae, as holotype; 5 pupal exuviae, Lake Store Hovvatn, Birkenes, Aust-Agder, Norway, 6/9/86, Ø. A. Schnell mature female pupa, Lake Jølster, Jølster, Sogn & Fjordane, Norway, 18/8/87, H. Sægrov; mature male pupa, Lake Litlebøvatn, Volda, Møre & Romsdal, Norway 26/7/86, Ø. A. Schnell; Other material (?): Male, Nordseter, Lillehammer, Oppland, Norway, 31/8/86, R. Bergo.

Diagnostic characters

The normal clypeus and cibarial pump combined with the moderately short acrostichals starting some distance from the scutal projection and the few setae on the wing membrane will separate the species from other *Heterotrissocladius* except *H. maeaeri* Brundin. However, the stipes is reduced, the wing slightly darker, the AR lower (0.7–1.1), the LR_1 higher (0.76–0.78) and the number of setae in cell r_{4+5} usually lower (7–18, except in one mature male pupa apparently with about 50 setae and another possible specimen with 45 setae, see remarks) in *H. brundini* spec. nov. The pupa can be separated from other members of the genus by means of the large frontal warts and the imbedded spines on segments VI-VIII. The larva can be distinguished by the narrowly separated two median teeth of the mentum with distinct lateral notches, the brownish black submentum which is conspicously darker than the surrounding areas of the head capsule, and the VM ratio of 1.1–1.5.

Etymology: Named in honour of Prof. emer. Lars Z. Brundin to his 80 year birthday and to signify his eminent contribution to chironomidology and lake typology where *Heterotrissocladius* has occupied a central position.

Description

Male imago (n = 7–9, except when otherwise stated).

Total length 3.93–4.22, 4.03 mm (6). Wing length 2.10–2.19, 2.14 mm (4). Total length/wing length 1.82–1.96, 1.90 (4). Wing length/length of profemur 2.44–2.55, 2.50 (4). Coloration brown with central parts of scutellum conspicuously pale. Wing pale yellowish brown.

Head. Eye with weak microtrichia between all ommatids. AR 0.92–1.05, 0.98 with one antenna of one specimen with an AR of 0.68. Ultimate flagellomere 424–484. 460 µm long with one antenna of one specimen with ultimate flagellomere 381 µm long. Pedicel 129–160, 139 µm wide. Temporal setae 10–17, 14, including 3–5, 4 inner verticals; 2–5, 4 outer verticals; and 5–8, 7 postorbitals. Clypeus 123–138, 132 µm wide; with 6–13, 10 setae. Cibarial pump, tentorium and stipes as in Fig. 1 A, of doubtful specimen from Nordseter as in Fig. 1 B. Tentorium 150–176, 162 µm long, 35–55, 42 µm wide. Stipes with reduced sclerotization in basal half and reduced median plate; 105–139, 120 µm long; 19–38, 26 µm wide (normal in possible specimen from Nordseter, see remarks). Palp lengths (micrometers): 29–45, 32; 41–62, 51; 109–149, 134; 86–103, 98; 106–138, 125. Third palpal segment with 2–4, 3 (6) sensilla clavata at apex.

Thorax (Fig. 1 C). Antepronotum with 6–14, 11 setae. Dorsocentrals 15–25, 18; acrostichals 5–9, 7, starting some distance from scutal projection ranging from 1/3–1/2 the length of scutum, longest acrostichal 38–56, 45 µm long; prealars 7–9,8. Scutellum with 16–23, 19 setae.

Wing (Fig. 1 D). VR 1.13–1.19, 1.16 (4). Brachiolum with 1–2, 2 setae; R with 11–15, 13 (6): R_1 with 4–11, 7 (6); R_{4+5} with 7–10, 9 (6); M_{1+2} with 0–8, 2 setae; other veins bare. Cell r_{4+5} with 7–18, 14 (5) setae, apparently with about 50 setae in mature male pupa from Volda; cell m_{1+2} with 0–3, 1 seta; cell an with 0–1, 0 setae. Squama with 18–21, 19 setae.

Legs. Spur of front tibia 47–56, 50 μm long; spurs of middle tibia 35–38, 36 μm and 21–34, 25 μm long; of hind tibia 50–67, 62 μm and 18–26, 22 μm long.

Width at apex of front tibia 44–50, 47 μm (4); of middle tibia 47–53, 49 μm (4); of hind tibia 56–59, 56 μm (4). Comb with 11–12, 11 setae; shortest seta 21–29, 24 μm long; longest seta 53–70, 61 μm long. Sensilla chaetica absent. Lengths (micrometers) and proportions of legs (n = 4):

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
P_1	849-860 857	884-920 905	681-717 696	341-382 360	245-263 258	179-185 181	126-132 127	0.76-0.78 0.77	2.58-2.70 2.66	2.47-2.56 2.53	2.6-3.0 2.8
P_2	801-860 837	777-848 822	406-418 412	227	167-173 170	131	114-120 116	0.49-0.52 0.50	3.10-3.27 3.22	3.88-4.12 4.02	2.0-2.8 2.4
P_3	884-956 935	920-1004 980	568-6.21 599	311-335 323	251-263 260	155-167 158	126-132 131	0.60-0.62 0.61	2.80-2.94 2.89	3.15-3.28 3.20	3.8-4.8 4.2

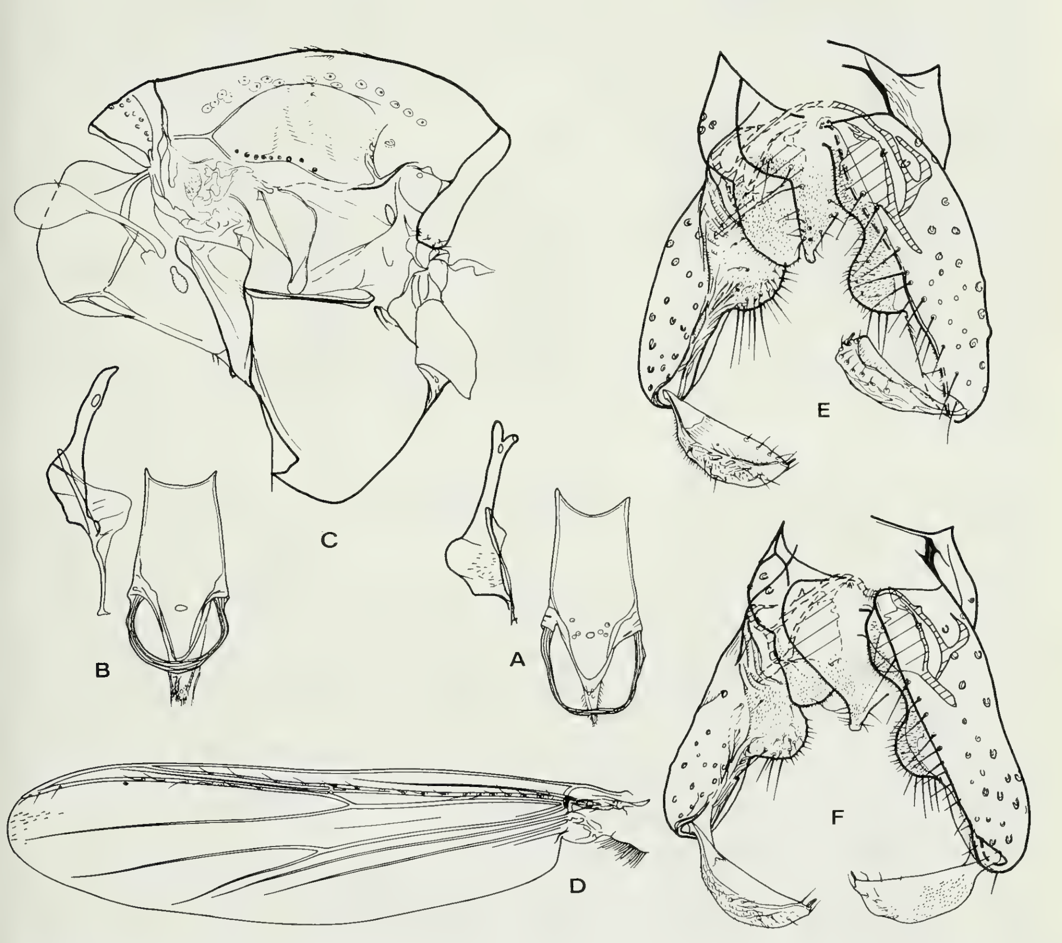


Fig. 1. *Heterotrissocladius* spp, male imago: A, C–E. *H. brundini* spec. nov; B, F. *H. brundini* or *maeaeri* (Brundin); A, B. Cibarial pump, tentorium and stipes; C. Thorax; D. Wing; E–F. Hypopygium.

Hypopygium (Fig. 1E). Anal point 53–70, 63 μm long; tergite IX including anal point with 20–27, 23 setae; laterosternite IX with 4–8, 7 setae. Phallapodeme 117–139, 125 μm long; transverse sternapodeme 106–116, 111 μm (6) long. Virga very weak and inconspicuous, consisting of one or

two clusters of all together 6–7 spines; 11–15, 13 μm (5) long. Gonocoxite 255–278, 268 μm long; inferior volsella rounded, with long setae on distal side. Gonostylus 117–141, 127 μm long; outer margin rounded; crista dorsalis long, relatively pronounced, rounded near apex; megaseta 10–15, 12 μm long. HR 1.96–2.28, 2.12; HV 2.95–3.46, 3.18.

Female imago (n = 9–11, except where otherwise stated).

Total length 3.28–4.00, 3.61 mm. Wing length 2.11–2.33, 2.18 mm. Total length/wing length 1.51–1.80, 1.66. Wing length/length of profemur 3.01–3.24, 3.12 (8). Coloration as in male.

Head. Flagellomere lengths (micrometers): 83–109, 98; 45–60, 55; 53–64, 59; 56–69, 64; 120–156, 136. Pedicel 68–82, 73 μm wide. AR 0.44–0.55, 0.50. Temporals 9–14, 12; including 4–6, 5 inner verticals; 2–5, 3 outer verticals; and 2–5, 3 postorbitals. Clypeus 138–161, 151 μm wide; 1.85–2.22, 2.06 times as wide as pedicel; with 7–15, 11 setae. Tentorium 138–154, 146 μm (8) long; 18–26, 22 μm (8) wide. Stipes 86–149, 118 μm (8) long; 9–23, 16 μm (8) wide. Palp segments length (micrometers): 26–35, 31; 38–49, 43; 82–103, 94; 68–88, 78 (7); 98–135, 118 (7). Two specimens with fourth and fifth palp segments fused; 120–135 μm long. Third palpal segment with 3–5, 4 sensilla clavata at apex. Coronal suture incomplete; 64–98, 82 μm long.

Thorax. Antepronotum with 8–17, 11 lateral setae. Dorsocentrals 14–29, 19; acrostichals 4–7, 5; prealars 6–10, 8. Scutellum with 16–24, 19 setae.

Wing. VR 1.11–1.16, 1.13. Brachiolum with 2 setae; R with 12–25, 17; R_1 with 5–13, 8; R_{4+5} with 12–33, 24; M_{1+2} with 0–2, 1 setae; other veins bare. Cell r_{4+5} with 23–54, 36; cell m_{1+2} with 4–17, 13 (8) setae; cell an with 2–14, 6 (8) setae. Squama with 15–25, 21 setae.

Legs. Spur on front tibia 41–56, 50 μm long; spurs on middle tibia 30–41, 37 μm and 23–34, 28 μm long; on hind tibia 60–71, 66 μm and 18–26, 24 μm long. Width at apex of front tibia 38–47, 43 μm; of middle tibia 41–53, 48 μm; of hind tibia 49–59, 53 μm. Comb of 7–10, 8 setae; shortest seta 23–34, 29 μm long; longest seta 49–67, 56 μm long. Sensilla chaetica 1–7, 4 at 0.20–0.30, 0.28 (8) to 0.40–0.60, 0.53 on ta_1 of hind leg; apparently absent in mid leg. Lengths (micrometers) and proportions of legs (n = 7–9):

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
P_1	669-753 697	753-848 793	548-624 582	274-321 291	194-217 200	137-151 143	99-131 106	0.72-0.76 0.74	2.68-2.92 2.87	2.47-2.63 2.54	2.1-3.1 2.9
P_2	690-807 716	717-807 749	359-384 377	191-227 203	142-167 149	95-120 106	85-114 99	0.49-0.51 0.50	3.23-3.47 3.31	3.76-4.10 3.89	2.1-3.0 2.5
P_3	784-896 817	884-992 921	548-624 576	293-335 303	227-263 242	135-161 144	99-134 114	0.61-0.65 0.63	2.78-2.98 2.88	2.88-3.10 3.02	2.9-3.9 3.3

Abdomen. Number of setae on tergites I-VIII as: 33–53, 42; 38–46, 42; 26–40, 25; 24–44, 34; 24–38, 31; 19–35, 28; 19–35, 24; 9–26, 16. Number of setae on sternites I-VIII as: 0; 3–7, 5; 5–10, 7; 8–17, 11; 12–20, 15; 14–24, 17; 15–23, 18; 43–71, 56.

Genitalia (Fig. 2). Gonocoxite with 13–20, 16 setae. Tergite IX well divided, with 20–31, 25 setae. Cercus 114–142, 133 μm long. Seminal capsule 76–101, 86 μm (8) long; excluding 11–26, 17 μm long neck; 64–79, 71 μm wide. Notum 105–161, 132 μm long.

Pupa (n = 11, except when otherwise stated)

Total length 3.76–4.78, 4.31 mm (9). Length of thoracic horn/length of anal macrosetae 1.10–1.50, 1.34. Thorax of exuviae pale brownish grey, abdomen nearly transparent.

Cephalothorax. Frontal warts (Fig. 3 A) conspicuous, 82–117, 97 μm high; 35–53, 40 μm (10) wide at base. Frontal setae on frontal apotome; 59–83, 73 μm (8) long. Postorbitals 59–73, 66 μm (4) and 41–56 μm (2) long. Median antepronotals 117–147, 140 μm (9) and 103–132, 120 μm long; lateral antepronotals 73–88, 80 μm and 0–44, 9 μm long (when absent reduced to setal mark). Thoracic horn (Fig. 3 B) 290–396, 349 μm long; 44–70, 54 μm (9) wide; 5.44–8.00, 6.57 (9) times as long as wide. Anterior dorsocentral 44–88, 65 μm long; Dc_2 53–117, 88 μm long; Dc_3 32–129, 68 μm long;

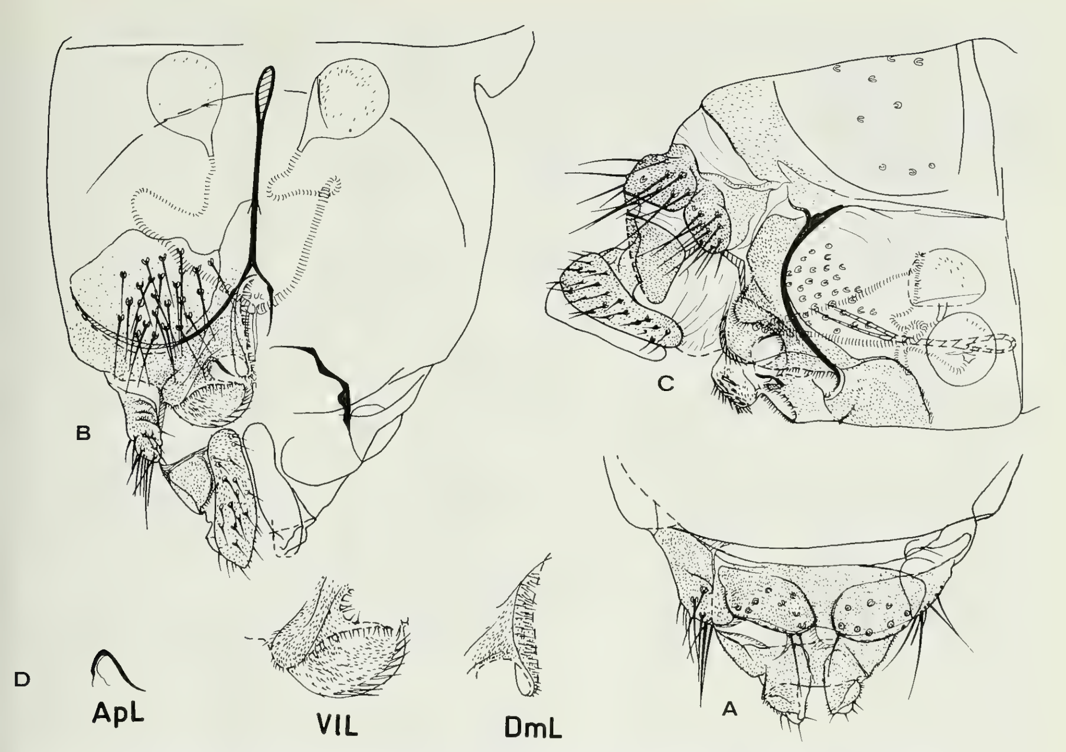


Fig. 2. *Heterotrissocladius brundini* spec. nov, female genitalia: A. Dorsal view; B. Ventral view; C. Lateral view; D. Lobes of gonapophysis VIII (DmL dorsomesal lobe; VlL, ventrolateral lobe; ApL, apodeme lobe).

Dc_4 64–88, 78 μm long. Distance between Dc_1 and Dc_2 18–67, 42 μm; between Dc_2 and Dc_3 15–53, 28 μm; between Dc_3 and Dc_4 23–82, 58 μm. Prealar observed in one specimen, 18 μm long. Wing sheath with fine marginal lines.

Abdomen (Fig. 3 C, D). Shagreen absent on tergite I (T I) and T IX, weak median on T II, more extensive and stronger posterior on TIII–VI, weak anteriomedian on T VII–VIII. Sternites I (S I) and IX bare, S II–III with weak anterior and median shagreen, S IV–VII with weak anterior shagreen and a few posterior spinules as S VI. Pedes spurii A present on sternites IV-VII and occasionally VIII (3 individuals). Pedes spurii B wider than high. Caudal hooklets 20–40, 32 on T II. Sternite VIII of male with 19–33, 27 (7) posterior spines. Caudolateral corners of segments VI–VIII with imbedded spines, distinct on VII, only indicated on VI and VIII. L setae on segments I–VIII as: 1–2 (4): 3: 3: 3: 3: 3: 3–4, 3: 5; 3 lamelliform on VII, 4 lamelliform on VIII, occasionally also fifth L seta on VIII slightly lamelliform. Anal lobe 269–337, 302 μm long; with 19–25, 22 setae in fringe; anal macrosetae 234–293, 261 μm long. Genital sac of male overreaching anal lobe by 88–124, 109 μm (4).

Larva (n = 6, except when otherwise stated)

Total length about 6 mm (larval exuviae). Head capsule length 447–502 μm (3).

Head. Antenna as in Fig. 3E. Lengths of antennal segments (micrometers): 82–88, 86; 35–41, 36; 3–4, 4; 18–22, 19 (4); 6–9, 7 (4); 4–6, 4 (4). AR 1.07–1.16, 1.12 (4). Basal antennal segment 18–21, 20 μm wide; 4.05–4.32, 4.24 times as long as wide; distance from base to annular organ 9–18, 15 μm; to distal mark of seta 21–35, 31 μm; blade at apex 50–64, 50 μm long; accessory blade 7–9, 9 μm long. Subapical style of second segment 6–9, 7 μm (5) long. Labrum and epipharyngeal areas as in

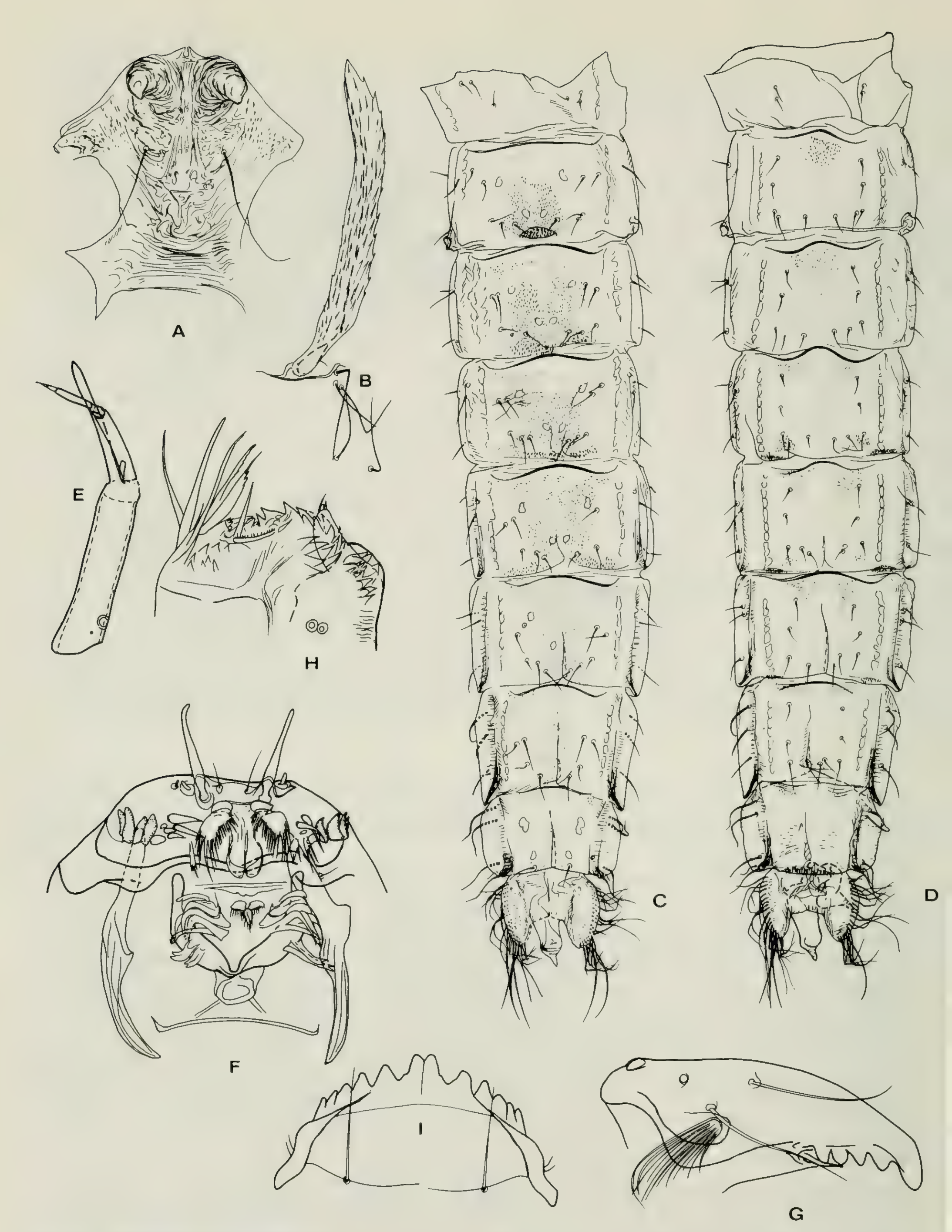


Fig. 3. *Heterotrissocladius brundini* spec. nov, pupa: A. Frontal apotome; B. Thoracic horn; C. Tergites of male; D. Sternites of male. – larva: E. Antenna; F. Labrum and epipharyngeal area; G. Mandible; H. Maxilla; I. Mentum.

Fig. 3F. S I broad, finely plumose. Labral lamellae rounded apically. Median spine of pecten epipharyngis narrower than lateral spines. Premandible 79–85, 83 μm (5) long. Mandible (Fig. 3G) 158–176, 168 μm (4) long. Maxilla as in Fig. 3H. Mentum (Fig. 3I) with two close median teeth each with distinct lateral accessory tooth, width of one median tooth including accessory tooth 18–21, 19 μm; ventromental plates 21–26, 25 μm (4) wide; 1.08–1.50, 1.32 times as wide as one median tooth including accessory tooth. Postmentum distinctly darker than surrounding areas of head capsule; 208–229, 222 μm long.

Abdomen. Procercus 38–47, 43 μm high; 29–32, 31 μm wide; anal setae 647–747, 706 μm (5) long. Supraanal seta 234–264, 242 μm long; 0.32–0.35, 0.34 (5) times as long as anal setae. Anal tubules and posterior parapods not measurable.

Remarks

A male imago from Nordseter near Lillehammer is not included in the type material. Judging from the leg proportions and the antennal ratio the specimen belong to *H. brundini.* The normally sclerotized stipes (132 μm long, Fig. 1B) and the more numerous setae on the wing membrane (45 setae in cell r_{4+5}, 7 setae in each of m_{1+2} and m_{3+4}), however, indicate that it belongs to *H. maeaeri.* The hypopygium (Fig. 1F) could belong to any of the two species. Associated pupal material is needed to decide whether the stipes and the wing setation is more variable within *H. brundini* or whether the specimen represents *H. maeaeri* or an additional new species.

The pupa described by Langton (1984: 88) do not quite fit *H. brundini.* The thoracic horn of *Heterotrissocladius* Pe I of Langton is wider (length/width 4.0–5.1), and there are more numerous setae in the anal lobe fringe (26–30). These variations, however, probably is not more than can be expected between various populations.

Ecology and distribution

H. brundini has been found in two acidified lakes in Southern Norway, two lakes in the provinces of Møre & Romsdal and Sogn & Fjordane, and in Lake Assynt in the Sutherland District of Scotland. It could conceivably be an indicator species of oligotrophic acid lakes.

Systematics

Sæther (1975: 57–62, fig. 15) does a phylogenetic analysis of *Heterotrissocladius* and related genera. In the scheme of argumentation *H. brundini* will be synapomorphous for trends 57, 58, 59, 60; 9, 10, 11; and 51, 52, showing that the species is a good *Heterotrissocladius.* It is symplesiomorphous for trends 41 and 44, apomorphous for trends 42 (reduced acrostichals) and 43 (reduced number of setae on the wing membrane). The last two trends show parallelisms between the *subpilosus* and the *maeaeri* groups. However, there are no pearl rows on the pupal wing sheaths (trend 37), only 4 filamentous setae on segment VIII of the pupa (trend 39), and no setae dorsad of the genital sac (trend 40), showing that the species belong with the *maeaeri* and *marcidus* groups. However, the pedes spurii A which may occur on sternite VIII and the fifth L seta which in some specimen is somewhat filamentous, indicate a plesiomorphic position within these groups.

The species is synapomorphous with *H. maeaeri* for trends 32 (short acrostichals) and 35 (distribution of L setae in pupa). It is plesiomorphous for trends 33 (PSB), 34 (PSA), 36 (median teeth of mentum), and apomorphous for trends 30 (setae on male tergite IX) and 31 (AR of larva), indicating a placement in the *marcidus* group. However, trends 30 and 31 are not very significant, representing continuous variation and probably good only as specific autapomorphies. Also several additional synapomorphies between *H. maeaeri* and *H. brundini* can be found in the male hypopygium in the shape of the inferior volsella, the inner margin of the gonocoxite and in the shape of the gonostylus. We feel relatively certain about the phylogenetic position of the species as the sister species of *H. maeaeri.*

There are few problems fitting the imagines and the pupa within the concept of the *maeaeri* group (SÆTHER 1975: 22); the stipes of the imagines and the pedes spurii B of the pupa have to be deleted as distinguishing characters. However, the larva will key to *H. marcidus* (Walker) in the larval key (SÆTHER 1975: 9) because of the two median teeth of the mentum. The median teeth, however, are closer together than in other described species except for *Heterotrissocladius* sp. E from Lake Superior (SÆTHER 1975: 55) which is mentioned as intermediate between the *marcidus* and *maeaeri* groups. *Heterotrissocladius* sp E almost certainly is close to *H. brundini.* A redefinition of the *maeaeri* group to include larvae with median teeth close together and distinct accessory teeth will make a separation between the *maeaeri* and *marcidus* groups still feasible.

The imbedded spines found in the pupa is nearly unique within the orthoclads, otherwise found in some members of *Zalutschia* Lipina only. SÆTHER (1976) did not attempt to classify *Oliveridia* Sæther, *Hydrobaenus* Fries, *Trissocladius* Kieffer and *Zalutschia* combined as a monophyletic group. According to SÆTHER (1977: 82), however, the genera apparently form a monophyletic unit based on the shape of the female gonapophysis VIII. This trend, however, is rather insecure as similar gonapophyses occur elsewhere including in the *Heterotrissocladius* group of genera. It thus is possible that *Zalutschia* is more closely related to the *Heterotrissocladius* group than to *Hydrobaenus,* and that the imbedded spines represent an underlying synapomorphy occurring in some, bot not all members of both *Zalutschia* and *Heterotrissocladius.* We have observed indication of imbedded spines also in some exuviae of *H. marcidus.* On the other hand the imbedded spines merely represent a strengthening of the paratergital margin and could easily be a result of parallel selection.

The larvae of *Heterotrissocladius* all have hair-like spines at base of the anterior parapods similar to those illustrated by STRENZKE (1950 fig. 11) for *Paraphaenocladius* Thienemann, but not found in *Parametriocnemus* Goetghebuer or apparently in the same form in other orthoclads. However, other synapomorphies seem to confirm the relationship shown by SÆTHER (1975 fig. 15) and these spines must be regarded either as secondarily reduced in *Parametriocnemus* or as an underlying synapomorphy for the whole group.

Acknowledgements

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Two new species of the Rheocricotopus (R.) effusus group

(Diptera, Chironomidae)

By Ole A. Sæther & Øyvind A. Schnell

Abstract

Two new species belonging to the *Rheocricotopus (Rheocricotopus) effusus* group are described; *R. (R.) reduncus* spec. nov. as male imago and pupa; *R. (R.) unidentatus* spec. nov. as male and female imago, pupa and larva. *R. (R.) reduncus* is intermediate between *R. (R.) pauciseta* Sæther and the rest of the *effusus* group. *R. (R.) unidentatus* is intermediate between *R. (R.) effusoides* Sæther and *R. (R.) effusus* (Walker).

Introduction

The genus *Rheocricotopus* Thienemann & Harnish, 1932, recently was revised (Sæther 1985). It was divided into two subgenera, *Psilocricotopus* Sæther and *Rheocricotopus* s. str. Of the three species groups in *Rheocricotopus* s. str. only the *effusus* group clearly was shown monophyletic.

Recently Michael Bolton from the Ohio EPA in Columbus, Ohio, sent the senior author some reared specimens collected in a spring stream in Ohio. These specimens showed a puzzling combination of characters. The pupa appeared to belong to *R. (R.) effusoides* Sæther, while the adults apparently belonged in *R. (R.) effusus* (Walker). The associated larva, however, had a single median mental tooth and thus resembled *R. (R.) tuberculatus* Caldwell. A closer examination showed that also the pupa and the adult could be separated from the closest related species although perhaps only in insignificant details. The species is described below as *R. (R.) unidentatus* spec. nov.

The junior author during investigations around the Jostedal Glacier, found some males and pupal exuviae of a species of the *effusus* group in the partly glacier fed river Jostedøla. The males appeared quite similar to *R. (R.) pauciseta* Sæther except for the quite distinct superior volsella, while the pupa showed similarities to *R. (R.) tuberculatus* with L-setae on segments V–VIII as 3:3:3:4–5. The species is described below as *R. (R.) reduncus* spec. nov.

Methods and morphology

Morphological nomenclature follows Sæther (1980), with the exception that the apical spine of the gonostylus is termed the megaseta. The measurements are given as ranges followed by a mean when four or more measurements are made, followed by the number measured in parentheses (n). In the figures of the male hypopygia the dorsal aspect is shown to the left, the ventral aspect and the apodemes to the right.

The type material is kept at the Museum of Zoology, University of Bergen, Norway (ZMB).

Rheocricotopus (Rheocricotopus) reduncus spec. nov.
(Figs. 1; 2 A, C, E)

Type locality: Jostedøla River, Luster, Sogn & Fjordane, Norway.

Type material: Holotype, male, Jostedøla River at inlet to small lake, Luster, Sogn & Fjordane, Norway, 23/7/86, A. Fjellheim and Ø. A. Schnell (ZMB No. 116). Paratypes: 3 males, 1 male pupa, 7 pupal exuviae, as holotype.

Diagnostic characters

The strongly curved, narrow-based, tooth-like projection of the superior volsella combined with the small and indistinct humeral pit will separate the male from other members of the genus. The median spine patches on the tergites grading over in shagreen, presence of pedes spurii B on segment II, combined with L setae of segments V–VIII as 3:3:3:4–5 will separate the pupa from other known pupae of the genus.

Etymology: From Latin, *reduncus,* curved (hooked) backwards, referring to the shape of the superior volsella.

Description

Male imago (n = 4, except when otherwise stated).

Total length 2.69–2.90, 2.80 mm. Wing length 1.58–1.73, 1.94 mm. Total length/wing length 1.41–1.47, 1.45. Wing length/length of profemur 3.01–3.11, 3.06. Coloration dark brown.

Head. AR 0.83–0.90, 0.87. Ultimate flagellomere 402–442, 426 μm long. Temporal setae 5–7, 6; including 0–1, 1 inner vertical; 0–2, 1 outer vertical; and 3–5, 4 postorbitals. Clypeus with 10–20, 16 setae. Cibarial pump, tentorium and stipes as in Fig. 1 A. Tentorium 149–155, 151 μm long; 29–31, 29 μm wide. Stipes 149–161, 154 μm long; 53–64, 60 μm (3) wide. Palp segments length (micrometers): 23–29, 27; 59–64, 62; 88–104, 99; 94–105, 100; 155–177, 167. Third palpal segment with 1–3, 2 sensilla clavata.

Thorax (Fig. 1 B). Antepronotum with 6–9, 8 (5) lateral setae. Humeral pit small and indistinct. Dorsocentrals 7–9, 8 (5); acrostichals 7–9, 8, all situated in front except for in one specimen with an additional median seta, longest acrostichals 44–47, 46 μm (5) long; prealars 2–3, 3 (5). Scutellum with 6–10, 8 (5) setae.

Wing (Fig. 1 C). VR 1.10–1.16, 1.13. Wing membrane with punctation visible at 250×. Anal lobe reduced. C extension 35–59, 52 μm long. Brachiolum with 1–2, 1 seta; R with 6–8, 7; R_1 with 0–1, 0; R_{4+5} with 0–1, 1; C extension with 0–3, 1 non-marginal setae. Squama with 2–3, 3 setae.

Legs. Spur of front tibia 43–47 μm (2) long; spurs of middle tibia 18–25, 21 μm (5) and 15 μm (2) long; of hind tibia 44–50, 47 μm and 16–18 μm (2) long. Width at apex of front tibia 38–41, 40 μm; of middle tibia 41 μm; of hind tibia 47 μm. Comb of 12–14, 13 setae; shorter seta 21–23, 23 μm (5) long; longest seta 44–56, 49 μm long. Sensilla chaetica 0–1, 0 (5) at 0.25 of ta_1 of middle leg; 1–3, 2 (5) at 0.20–0.35 of ta_1 of hind leg. Lengths (micrometers) and proportions of legs:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BU	SV	BR
P_1	609-681 645	735-807 777	490-526 511	311-335 325	221-227 226	137-149 143	84-90 89	0.65-0.67 0.66	2.42-2.52 2.48	2.74-2.83 2.78	2.4-2.7 2.6
P_2	681-741 711	681-735 711	347-376 360	197-125 208	143-155 148	72-84 80	72-84 81	0.50-0.51 0.50	3.42-3.52 3.48	3.92-4.02 3.95	3.0-3.3 3.2
P_3	645-729 689	789-878 843	454-478 466	245-263 254	191-209 200	90-108 98	71-84 78	0.53-0.58 0.56	3.11-3.20 3.16	3.16-3.39 3.29	3.4-4.1 3.9

Hypopygium (Fig. 1 D). Anal point 38 μm (2) long; with 6–11, 9 (5) setae; laterosternite IX with 3–5, 4 (5) setae. Phallapodeme 67–76, 72 μm long; transverse sternapodeme 79–98, 88 μm long. Gonocoxite 202–220, 208 μm long; with strongly developed, digitiform, narrowbased, caudomesal projection of superior volsella, superior volsella 59–67, 64 μm (5) long; inferior volsella single, blunt-

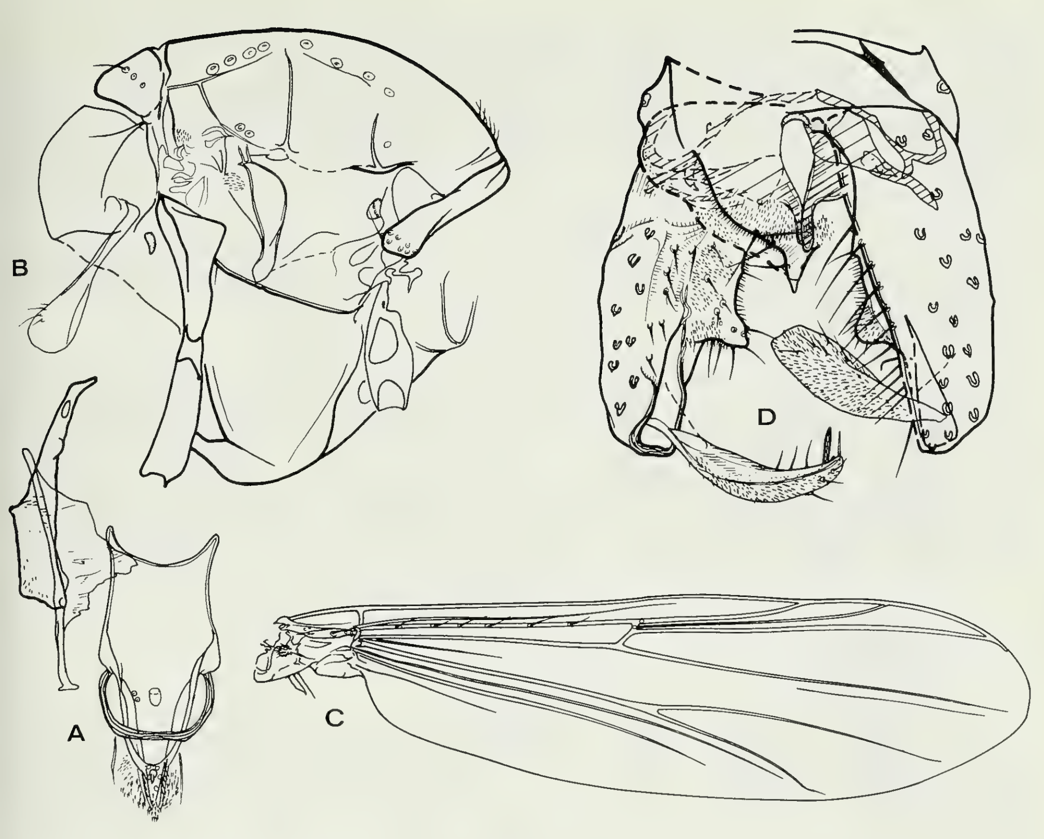


Fig. 1. *Rheocricotopus (Rheocricotopus) reduncus* spec. nov., male imago: A. Cibarial pump, tentorium and stipes; B. Thorax; C. Wing; D. Hypopygium.

tipped. Gonostylus 105–111, 109 μm long; crista dorsalis low, very long and relatively well developed, but appearing as absent in some views; megaseta 19–21, 20 μm (3) long. HR 1.82–2.00, 1.90; HV 2.48–2.63, 2.56.

Pupa (n = 8, except when otherwise stated).

Total length 3.38–3.80, 3.57 mm (7). Length of thoracic horn/length of anal macrosetae 1.00–1.17, 1.12 (7). Exuviae relatively dark greyish brown.

Cephalothorax. Frontal seta 44–73, 64 μm (7) long; on frontal apotome (Fig. 2A). Postorbitals 44–73, 63 μm (7) long. Median antepronotals 147–190, 172 μm (7) and 88–176, 134 μm long; lateral antepronotal 50–73, 59 μm long. Thoracic horn (Fig. 2C) 264–308, 295 μm (7) long; 47–56, 53 μm (4) wide. Anterior precorneal seta 132–176, 154 μm (6) long; median seta 88–147, 129 μm (4) long; posterior seta 44–59, 48 μm 15 long. Anterior dorsocentral (Dc_1) 26–82, 47 μm long; Dc_2 32–103, 75 μm long; Dc_3 26–53, 33 μm long; Dc_4 59–100, 72 μm long. Distance between Dc_1 and Dc_2 23–38, 28 μm; between Dc_2 and Dc_3 21–41, 31 μm; between Dc_3 and Dc_4 50–11, 70 μm.

Abdomen (Fig. 2E). Shagreen absent on tergite I (T I), weak anterior on T II, stronger and extensive on T III–VI, reduced laterally on T VII–VIII, present anterior on T IX. Sternites I (S I) and IX bare, shagreen anterior on S II; S III–IV with anterior and lateral S V–VII with extensive, S VIII with anterior shagreen. Pedes spurii A on S III–VI, sometimes indicated on S VII. Pedes spurii B on segment II, well developed. T II with about 120–170, 49 caudal hooklets. Conjunctives III/IV, IV/V and so-

metimes V/VI with anteriorly directed spinules. Number of spines in median patches on T IV–VI as: 10–45, 29; 35–80, 68; 55–80, 70. Maximal length (micrometers) of spines as: 6–12, 9; 12–18, 15; 9–18, 14. L setae on segments I–VIII as: 2, 3, 3, 3, 3, 3, 3, 4–5; all lamelliform on segments VII and VIIII. Anal lobe with 16–20, 18 setae in fringe; anal macrosetae 249–270, 263 μm long. Genital sac of male folded and not measurable in males, of female ending 64 μm (1) short of apex of anal lobe.

Larvae unknown

Remarks

The systematic positions of this and the following species are treated in the systematics part at the end of this paper.

Ecology and distribution

The male imagines, pupa and pupal exuviae all were collected in a back eddy where the river Jostedøla enters a small lake at Viva (alt. 850 m a. s. l.) in the uppermost part of the valley Jostedal. The type of locality is situated above the timber line only a few kilometers east of the Jostedal Glacier, which is the largest glacier on mainland Europe, covering an area of approx. 486 sq. km.

Some environmental parameters and a list of some other chironomids found at the locality is given by SCHNELL & SÆTHER (1987). At least three species, *Vivacricotopus ablusus* Schnell & Sæther, a new species of *Limnophyes* and *R. (R.) reduncus* spec. nov. appear to be endemic to the area.

Rheocricotopus (Rheocricotopus) unidentatus spec. nov.
(Figs 2B, D, F; 3; 4)

Type locality; Camp Lazarus, Delaware Co., Ohio, U.S.A.

Type material: Holotype, male with pupal and larval exuviae, spring stream, Camp Lazarus, Delaware Co., Ohio, U. S. A., 18/4/86, M. J. Bolton, in coll. Mus. Zool. Univ. of Bergen (ZMB No. 117).

Paratypes: 2 males reared from larva, 2 females, reared from larvae, 3 larvae, as holotype; 3 larvae as holotype except 1/4/86.

Diagnostic character

The high number of dorsocentrals (18–22 in males, 18–33 in females) and acrostichals (30–36 in males, 43–47 in females) will separate the imagines from *R. (R.) effusus* and *R (R.) effusoides,* the closest relatives. The pupa has more numerous spinules (65–120) in the spine patches of T V and VI than in *R (R.) effusus,* and a pale greyish brown coloration of the exuviae separating it from the darker colour of *R. (R.) effusoides.* The single median tooth of the mentum combined with the lack of ventral tubercles on the head capsule will separate the larva from other members of the genus.

Etymology: From Latin, *uni-*, one, and *dentatus,* toothed, referring to the single median tooth of the larval mentum.

Description

Male imago (n = 3, except when otherwise stated).

Total length 3.08–3.42 mm. Wing length 1.51–1.83 mm. Total length/wing length 1.87–2.04. Wing length/length of profemur 2.59–2.69. Coloration brown.

Head. AR 1.10–1.36. Ultimate flagellomere 394–563 μm long. Temporal setae 4–8, including 0–1 inner verticals, 1–4 outer verticals and 3 postorbitals. Clypeus with 10–14 setae. Cibarial pump, tentorium, and stipes as in Fig. 3A. Tentorium 146–169 μm long, 38–47 μm wide. Stipes 135–158 μm long, 45–53 μm (2) wide. Palp segments length (micrometers): 38–41, 68–81, 90–116, 101–124, 69–184. Third palpal segment with 2–3 sensilla clevata.

Thorax (Fig. 3B). Antepronotum with 4–8 lateral setae. Humeral pit very large, elongate ellipsoid with smaller rounded pit below. Dorsocentrals 18–22; acrostichals 30–36, the longest reaching

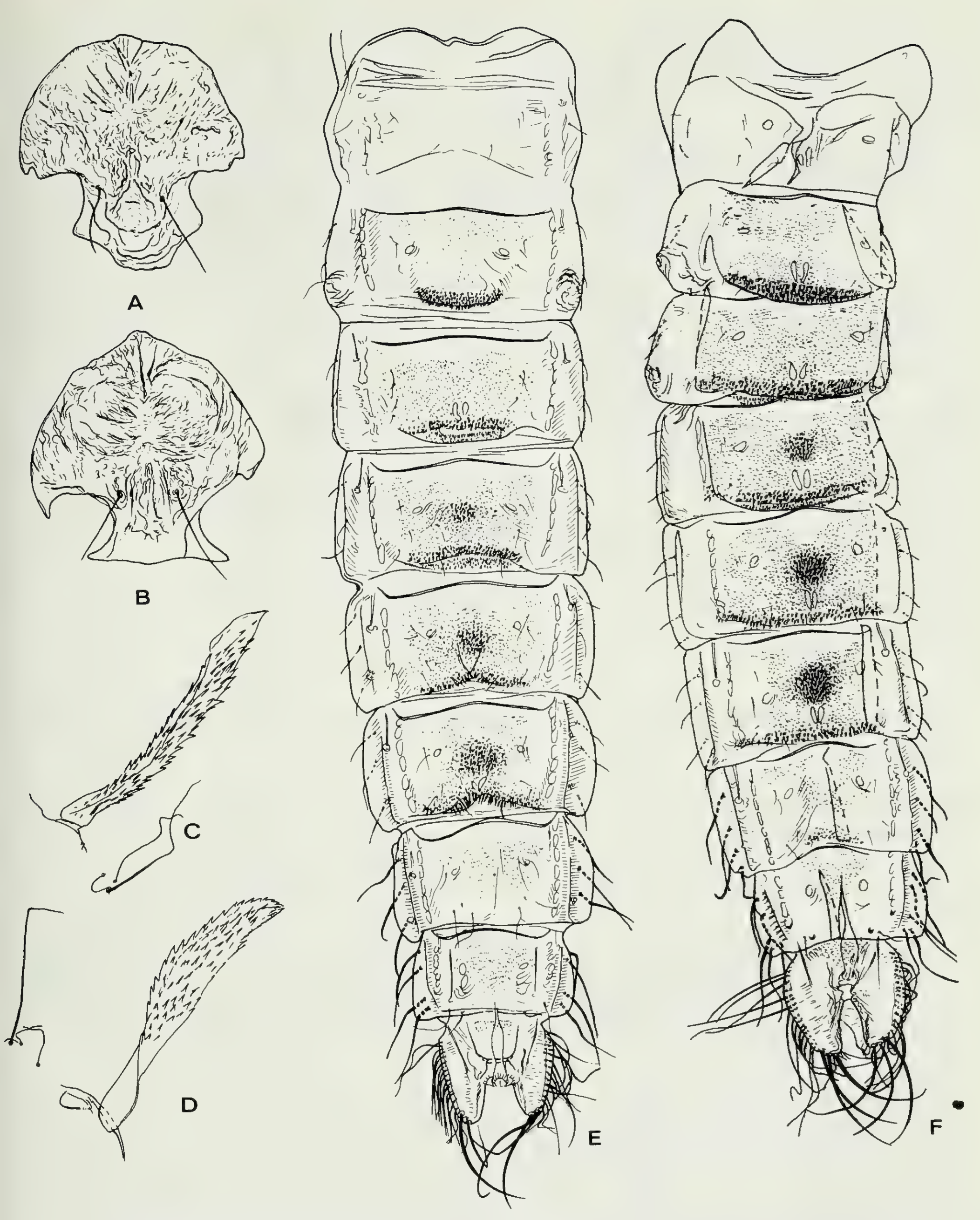


Fig. 2. *Rheocricotopus (Rheocricotopus)* spec., pupae: A–B. Frontal apodeme; C–D. Thoracic horn; E–F. Tergites. A, C, E. *R. (R.) reduncus* spec. nov.; B, D, F. *R. (R.) unidentatus* spec. nov.

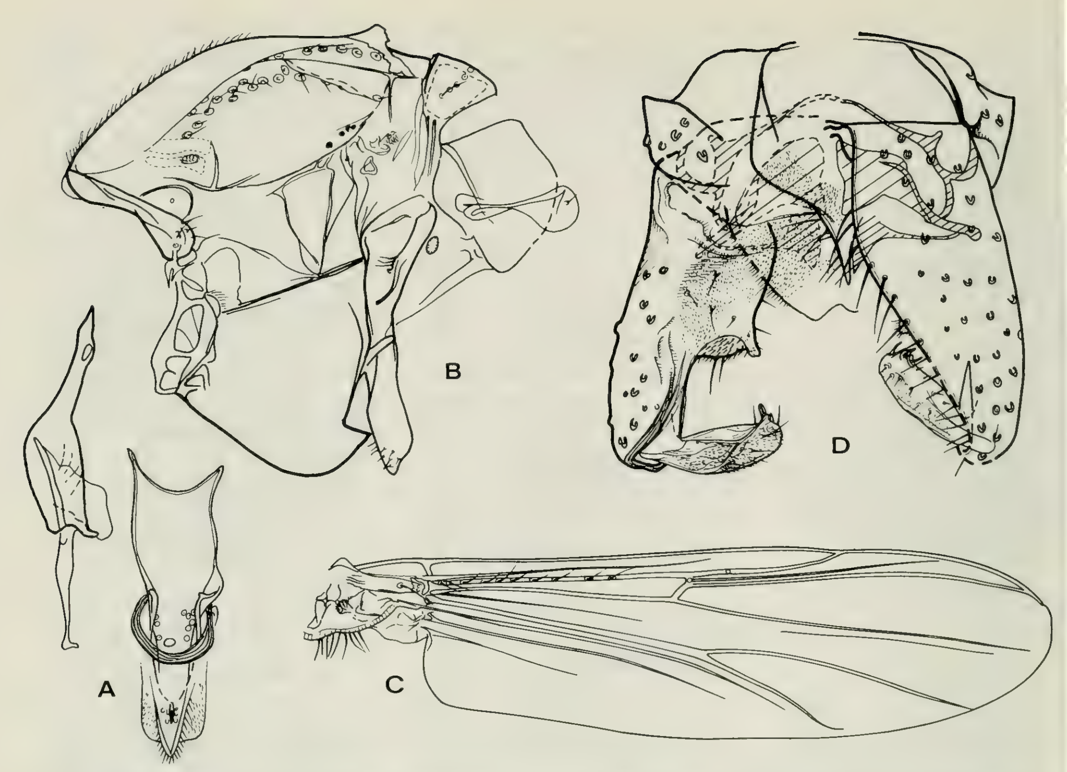


Fig. 3. *Rheocricotopus (Rheocricotopus) unidentatus* spec. nov., male imago: A. Cibarial pump, tentorium and stipes; B. Thorax; C. Wing; D. Hypopygium.

26–38 μm in length (15–26 μm in *R (R.) effusus* and *R (R.) effusoides);* prealars 4. Scutellum with 6–9 setae.

Wing. (Fig. 3C). VR 1.08–1.14. Wing membrane with fine punctation of microtrichia visible at 150×. Anal lobe protruding. C extension 38–49 μm long. R with 6–10 setae. Squama with 3–11 setae.

Legs. Spur of front tibia 49–64 μm long, spurs of middle tibia 21–26 μm and 19–23 μm long, of hind tibia 45–58 μm and 19–23 μm long. Width at apex of front tibia 34–41 μm, of middle tibia 38–49 μm, of hind tibia 41–53 μm. Comb of 11–12 setae, shortest seta 30–34 μm long, longest seta 49–60 μm long. Sensilla chaetica absent. Lengths (micrometers) and proportions of legs:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
P_1	567-709	662-841	493-595	265-340	180-236	123-151	61-80	0.71	2.60-2.71	2.56-2.60	2.2-2.8
P_2	576-747	586-747	302-395	1512-208	115-151	57- 80	47-66	0.52-0.53	3.58-3.97	3.72-3.84	2.5-2.7
P_3	558-709	671-869	397-491	203-274	165-222	80-113	57-71	0.57-0.59	3.04-3.22	3.02-3.21	3.2-4.4

Hypopygium (Fig. 3D). Anal point 41–60 μm long, with 8–12 setae, laterosternite IX with 5–6 setae. Phallapodeme 79–109 μm long, transverse sternapodene 99–154 μm long. Gonocoxite 218–251 μm long; with well developed tooth-like caudomesal projection on superior volsella, 62–71 μm long; inferior volsella single with pointed apex. Gonostylus 90–101 μm long; crista dorsalis low and long, relatively well developed, but not visible in some views; megaseta 13–15 μm long. HR 2.42–2.50; HV 3.39–3.47.

Female imago (n = 2, except when otherwise stated).

Total length 3.34–4.20 mm. Wing length 1.81–2.07 mm. Total length/wing length 1.85–2.03. Wing length/length of profemur 2.61–2.65. Coloration yellowish brown with dark brown separate vittae and thoracic markings, scutellum yellowish brown in central area.

Head. Flagellomere lengths (micrometers): 98–105, 56, 53–60, 60–64, 113–116. AR 0.41–0.45. Temporals 7–18, including 1–4 inner verticals, 2–8 outer verticals and 4–6 postorbitals. Tentorium 180 μm long, 38–41 μm wide. Stipes 161–180 μm long, 49–68 μm wide. Palp segments length (micrometers): 41–49, 79–86, 113–114, 128–133, 218–225. Third palpal segment with 2–3 sensilla clavata at apex. Coronal suture complete.

Thorax. Antepronotum with 8–10 lateral setae. Humeral pit as in male. Dorsocentrals 18–33; acrostichals 43–47, longest 38–49 μm long; prealars 6–7. Scutellum with 19–22 setae.

Wing. VR 1.01–1.16. C extension 79–90 μm long. Brachiolum with 1–2 setae, R with 22–37, R_1 with 10–17, R_{4+5} with 26–51, extended part of costa with 5–8 non-marginal setae. Squama with 9–22 setae.

Legs. Spur of front tibia 30–38 μm long, spurs of middle tibia both 23–26 μm long, of hind tibia 53–56 μm and 21–23 μm long. Width at apex of front tibia 43–53 μm, of middle tibia 45–56 μm, of hind tibia 53–73 μm. Comb of 12–14 setae, 30–60 μm long. Sensilla chaetica apparently absent. Lengths (micrometers) and proportions of legs:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
P_1	680-784	765-954	468-586	255-302	170-217	113-142	66-80	0.61	3.15-3.16	2.98-3.09	1.5-2.0
P_2	718-803	713-851	317-425	161-217	113-161	57- 85	57-76	0.44-0.50	3.79-4.51	3.89-4.52	1.5-1.8
P_3	671-794	784-959	421-539	208-279	161-227	76-109	61-85	0.54-0.56	3.26-3.71	3.25-3.46	1.3 (1)

Abdomen. Number of setae on tergites I–VIII as: 27–48, 34–66, 32–55, 39–55, 40–59, 39–49, 43, 36–47. Number of setae on sternites I–VIII as: 0, 0–3, 2–6, 7–11, 19–21, 23–29, 20–27, 28–46.

Genitalia (Fig. 4 A–C). Gonocoxite with 13–17 setae, including 7–8 strong and 5–10 weak setae. Tergite IX strongly divided with 22–26 setae. Cercus 90–128 μm long. Seminal capsule 101–116 μm long, including 23–30 μm long neck; 77–90 μm wide. Notum 139 μm long.

Pupa (n = 5, except when otherwise stated)

Total length 3.31–4.83, 3.92 mm. Length of thoracic horn/length of anal macrosetae 0.87–1.22, 1.00. Exuviae pale greyish brown, with darker apophyses and thoracic markings.

Cephalothorax. Frontal seta 90–120 μm (2) long, on frontal apotome (Fig. 2B). Vertical not measurable; postorbitals 23–49, 35 μm (4) long. Median antepronotals both 120–199, 163 μm long; lateral antepronotals 41–88, 62 μm long and small peg, 11–19 μm (3) long. Thoracic horn (Fig. 2D) 259–390, 303 μm long; 38–53, 44 μm wide. Anterior precorneal seta 131–233, 186 μm long; median seta 83–218, 165 μm long; posterior seta 49–161, 95 μm long. Anterior dorsocentral (Dc_1) 75–105, 82 μm long; other dorsocentrals each 41–101, 65 μm long. Distance between Dc_1 and Dc_2 64–116, 92 μm; between Dc_2 and Dc_3 15–83, 50 μm; between Dc_3 and Dc_4 23–53, 37 μm.

Abdomen (Fig. 2F). Shagreen absent on tergite I (T I), weak median on T II, stronger and more extensive on T III–VI, median on T VII–VIII, anterior on T IX. Sternites I (S I) and IX bare; shagreen on S II–III anterior, median and laterally; on S IV–VI posterio-laterally, not very strong; on S VII–VIII anterior group shagreen. Pedes spurii A present on S IV–VI with indications also on S VII–VIII in most specimens. Pedes spurii B well developed on segment II and present also on segment III. About 140–260, 150 caudal hooklets on T II. Conjunctives III/IV, IV/V and usually V/VI with rows of anteriorly divided spinules, medially interrupted or (in one specimen) absent on V/VI. Number of spinules in median patches on T IV–VI as: 34–75, 49; 65–118, 79; 68–120, 91. Maximal

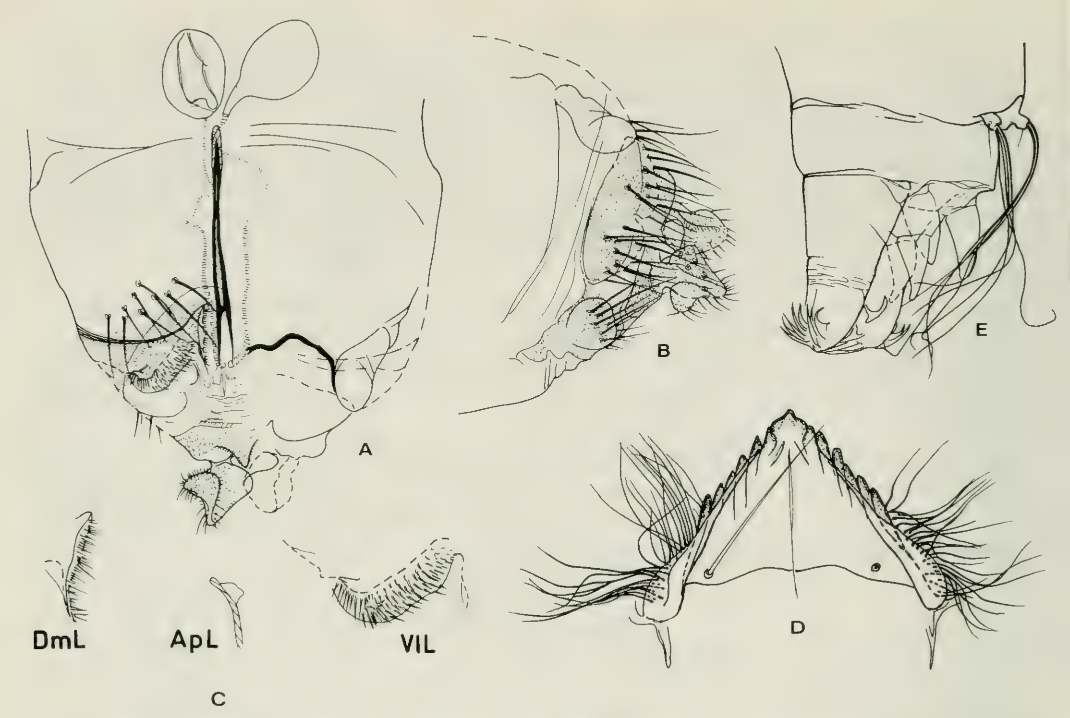


Fig. 4. *Rheocricotopus (Rheocricotopus) unidentatus* spec. nov., female imago and larva: A–C. Female genitalia, ventral (A) and dorsal (B) aspect and lobes of gonapohysis VIII (C) (DmL, dorsomesal lobe; VlL, ventrolateral lobe; ApL, apodeme lobe); D. Larval mentum; E. Posterior end of larva.

lengths (micrometers) of spines as: 11–23, 15; 15–26, 19; 15–26, 20. L setae on segments II–VIII as: 4, 4, 4, 4, 4, 4, 4–5; all lamelliform on segments VII–VIII. Anal lobe with 21–26, 23 setae in fringe; anal macrosetae 281–319, 301 μm long. Genital sac of male not measurable, of female ending 86–124 μm (2) short of apex of anal lobe.

Larva (n = 10–11, except when otherwise stated)

Total length 3.97–7.24, 5.15 mm. Head capsule length 397–473, 438 μm.

Head. Antenna as in *R. (R.) effusoides* Sæther 1985 (fig. 21 A). Lengths of antennal segments (micrometers): 69–87, 78; 16–23, 18; 9–14, 12; 7–9, 8; 7–9, 8. AR 1.55–1.96, 1.70. Basal antennal segment 15–24, 18 μm wide, distance from base to ring organ 8–15, 10 μm; to basal mark of seta 7–13, 9 μm (8); to distal mark 41–48, 44 μm (7). Lauterborn organs and apical style of second segment each 6–9, 8 μm long. Labrum as in *R. (R.) effusoides* (Sæther 1985 fig. 21 B). Premandible 69–79, 74 μm long. Mandible 116–158, 138 μm long; with 7 branches in seta interna. Mentum (Fig. 4 D) with one median tooth with lateral notches; width of median tooth including notches 27–38, 32 μm; ventromental plates 19–25, 22 μm wide; with 28–40, 33 setae underneath. Postmentum 223–249, 233 μm long.

Abdomen (Fig. 4 E). Procercus 30–38, 34 μm high; 21–28, 24 μm wide; with 5–6 anal setae 450–563, 520 μm long. Supraanal seta 98–131, 112 μm long; 0.90–0.23, 0.21 times as long as anal setae. Anal tubules 98–158, 118 μm long; 38–56, 49 μm wide at base. Posterior parapods 263–319, 290 μm (8) long.

Systematics

SÆTHER (1985) erected a scheme of argumentation delineating the cladogenesis of the genus *Rheocricotopus.* Both species treated here are synapomorphous for trends 17, symplesiomorphous for trends 18, showing that they both belong in the nominal subgenus.

Trends 16 contain six different trends of which all except one for each species are symplesiomorphous for both species. In *R. (R.) unidentatus,* however, there is a single median tooth of the mentum as in *R. (R.) tuberculatus;* and *R. (R.) reduncus* has L setae of the same distribution as in *R. (R.) tuberculatus.* However, none of these two trends are very significant since there is a tendency to reduction to one median mental tooth in for instance *R. (R.) effusoides,* and to reduction of the L setae in the *fuscipes* group. Trend 15 is synapomorphous for *R. (R.) unidentatus;* unknown, but probably also synapomorphous for *R. (R.) reduncus.* Both species are synapomorphous for trend 9, a highly significant trend. It is thus clear that both species belong in the *effusus* group.

R. (R.) reduncus is somewhat intermediate for trends 8, while the species is synapomorphous for the first of trends 7 (with tooth-shaped projection of the superior volsella), symplesiomorphous for the second (with small humeral pit). The phylogenetic placement thus is relatively obvious. It form the sister species of the rest of the *effusus* group minus *R. (R.) pauciseta,* while the latter form the sister species of *R. (R.) reduncus* plus the rest of the group. An alternative placement could be as the sister species of *R. (R.) pauciseta* alone, something further indicated by the similarity of the anal points of the two species.

The placement of *R. (R.) unidentatus* also is relatively simple. Trends 7 and 3 are synapomorphous, 8 and 4 symplesiomorphous, meaning that *R. (R.) unidentatus* belong in a group with *R. (R.) effusus* and *R. (R.) effusoides.* Trends 1 and 2 indicate that *R. (R.) effusus* is the closest species.

R. (R.) reduncus and *R. (R.) unidentatus* is compared with their closest relatives in Table 1.

Table 1. Comparisons of some members of the *Rheocricopus (R.) effusus* group. Lengths in μm.

	R. pauciseta	*R. reduncus*	*R. effusoides*	*R. unidentatus*	*R. effusus*
Male:					
AR	0.60 - 0.83	0.83 - 0.90	1.39 - 1.61	1.10 - 1.36	0.99 - 1.33
LR_1	0.62 - 0.74	0.65 - 0.67	0.64 - 0.67	0.71	0.70 - 0.74
No. dorsocentrals	5 - 7	7 - 9	12 - 16	18 - 22	9 - 16
No. acrostichals	12 - 17	7 - 9	14 - 21	30 - 36	18 - 26
Max. l. acrostichals	25	44 - 47	15 - 26	26 - 38	15 - 26
Humeral pit	small	small	large, ellipsoid	large, ellipsoid	large, ellipsoid
Anal point setae	6 - 8	6 - 11	15 - 20	8 - 12	5 - 13
HR	2.61 - 2.69	1.82 - 2.00	1.92 - 2.07	2.42 - 2.50	-
Female:					
No. acrostichals	-	-	21 - 22	43 - 47	18 - 26
Pupa:					
Coloration	pale yellowish brown	dark greyish brown	dark yellowish brown	pale greyish brown	pale greyish brown
L. frontal seta	84 - 100	44 - 73	56 - 101	90 - 120	38 - 64
W. thoracic horn	48 - 58	47 - 56	49 - 86	38 - 53	34 - 53
Spines patch T IV	ca. 0 - 15	10 - 45	6 - 43	34 - 75	22 - 46
" " T V	ca. 25	35 - 80	36 - 79	65 - 118	28 - 47
" " T VI	ca. 30	55 - 80	35 - 74	68 - 120	26 - 55
No. setae in fringe	11 - 13	16 - 20	18 - 27	21 - 26	11 - 21
Larva:					
Med. mental tooth	double	-	double	single	double
L. basal antennal segm.	62 - 64	-	70 - 86	69 - 87	55 - 69

Acknowledgements

We would like to thank the Norwegian Water Resource and Elektricity Board for financial aupport. We also are indebted to Mr. Michael Bolton, Ohio EPA, Columbus, Ohio, for the type material of *R. (R.) unidentatus* spec. nov., to Mr. Tien van Trieu for doing the illustrations, and to Mrs. I. Wiese-Hansen for typing the manuscript.

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A review of Lappodiamesa Serra Tosio, with the description of L. boltoni spec. nov. from Ohio, USA

(Diptera, Chironomidae)

By **Ole A. Sæther** and **Endre Willassen**

Abstract

The genus *Lappodiamesa* Serra-Tosio is emended. *Lappodiamesa brundini* Serra-Tosio is regarded as a junior synonym of *L. vidua* (Kieffer) comb. nov. The female of *L. vidua* and the male and female imagines, pupa and larva of *Lappodiamesa boltoni* spec. nov. are described in full detail. The genus apparently forms the sister group of *Pseudodiamesa* Goetghebuer.

Introduction

The previously monotypic genus *Lappodiamesa* was described by Serra-Tosio (1968) from two males collected by L. Brundin in N.-Sweden, close to the Norwegian border. The immature stages were unknown when the keys and diagnoses to the Holarctic Diamesinae were elaborated by Oliver (1983, 1986). After the initial description of *L. brundini* Serra-Tosio no additional records were made of the species until Makarchenko (1983) described the male, pupa and larva from the Chukotskii Peninsula. Having the opportunity to describe all stages of a recently discovered Nearctic species, we decided to examine putative types of *Syndiamesa vidua* Kieffer, a species which for a while has been suspected to represent a synonym of *L. brundini*. Through the courtesy of Dr. E. Makarchenko, we also were able to reexamine some specimens used in his description.

Methods

The material was mounted in Canadabalsam (Sæther, 1969) or in Euparal. Terminology follows Sæther (1980). In the descriptions measurements are given as ranges. When more than 4 specimens have been measured, the range is followed by a mean and the number of specimens measured in parenthesis.

Lappodiamesa Serra-Tosio, 1968, emended

Diagnosis

Male antenna plumose, female antenna with six or seven flagellomeres. Eyes with weak or strong pubescence, in male moderately extended medially. Frontal and orbital setae absent. Maxillary palp about as long as width of head, with weak indication of sensilla capitata on segment three or devoid of sensilla capitata. Antepronotum deeply notched dorsally. Acrostichals present or absent, dorsocentrals uniserial or biserial posteriorly. Wing membrane almost smooth (Makarchenko, 1983) or punctated with microtrichia, R_1 distinctly arched, FCu clearly proximal to FR, MCu slightly proximal of RM, R_{4+5} with a few setae distally, anal lobe prominent. Fourth tarsal segment of legs cylindrical and subequal in length to fifth segment. Male hypopygium with anal point and pars ventralis, with or with-

out rounded and setose superior volsella, and with weekly delineated inferior volsella. Female genitalia with 3 rounded seminal capsules, gonocoxite IX with moderate projection and tergite IX clearly divided into two setigerous protrusions. Pupa with rugulose cephalothorax, thoracic horn absent; abdomen reticulate with strong and dark apophyses on tergites and sternites, L-setae simple or bifid and mostly subequal; anal lobe overreaching genital sac, with 3 anal macrosetae, without fringe or median setae, with or without pointed apical tubercle. Larva with 2 pairs of serrate labral lamellae, labral sensilla S I–S III simple, pecten epipharyngis with 7 scales, premandible with 4–5 teeth, mentum with 1 median and 8–9 lateral teeth, body setae pale and moderately long, procercus about as long as wide with 8–9 anal setae and 2 subapical setae.

Lappodiamesa vidua (Kieffer) comb. nov.

Figs 1 A–C

Syndiamesa vidua Kieffer, 1922: 23–24, fig. 15.
Lappodiamesa brundini Serra-Tosio, 1968: 140–145, pl. 5. syn. nov.

Diagnosis

Female with 6 flagellomeres. Acrostichals present. R_{2+3} of wing ending close to R_1; male without superior volsella; female apparently without sensilla chaetica on front and middle legs. Pupa with distinct apical tubercle on anal lobe. Larva with first lateral teeth of mentum about equally wide as median tooth.

Male imago

Scutellum with more than 30 setae in 2–3 irregular rows. LR_1 0.64, LR_2 0.47, LR_3 0.57; BV_1 3.72, SV_1 2.72, SV_2 2.20, SV_3 3.38. Tergite IX (Fig. 1 A) with 22 setae, laterosternite with 14 setae; transverse sternapodeme 131 μm long, with or without distinct orolateral corners; phallapodeme 120 μm long, pars ventralis 34 μm long, gonocoxite 304 μm long, gonostylus 165 μm long. Otherwise about as in descriptions by Kieffer (1922), Serra-Tosio (1968) and Makarchenko (1983).

Female imago (n = 2)

Total length 4.53–4.58 mm. Wing length 3.37–3.58 mm. Total length/wing length 1.28–1.34. Wing length/length of profemur 3.64–3.68.

Head: Pedicel with 3–4 setae. Length of flagellomeres (μm): 83, 56–64, 53–56, 45–49, 49, 150–165. AR 0.57–0.59. Flagellomeres 1–3 with 1–2 apical sensilla coeloconica dorsally, ultimate flagellomere with about 20 sensilla chaetica and a few sensilla coeloconica. Ultimate flagellomere with 1–2 subapical setae. Coronal suture faint or reduced. Temporal setae 17–20, including 6–8 postorbitals, 7–9 inner- and 3–4 outer verticals. Eyes with strong pubescence (sensu Sæther, 1980). Clypeus with 5–7 setae. Palp segments 4 and 5 fused in one specimen; palp segments length (μm) in normal specimen: 45, 64, 131, 116, 154; about 4–5 sensilla clavata observed on palp segment 3. Tentorium 180–214 μm long. Stipes length/width 191/60–68 μm.

Thorax: Antepronotum with 9–12 lateral setae. Dorsocentrals 16–17, acrostichals 13–16, supraalars absent, prealars 10–13. Scutellars 38–43, in 3–6 rows.

Wing: VR 0.92–0.96. Costa produced 83–90 μm beyond R_{4+5}. Anal lobe with well developed projection. Microtrichia of wing membrane visible under 100× magnification. R with 10–13 setae, R_1 with 7–9, R_{4+5} with 6–9 setae. Alula with 4–5 setae. Squama with 40–50 setae. Subcosta with 3 sensilla campaniformia, R_1 with 1, R_{2+3} with 2 and R_{4+5} without sensilla campaniformia.

Legs: Spur of front tibia 68–71 μm, spurs of middle tibia 49 μm and 53–58 μm, of hind tibia 45–51 μm and 77–85 μm long. Width at apex of front tibia 64–71 μm, of middle tibia 60 μm, of hind tibia 79–86 μm. Comb on hind tibia with 7–9 setae 45–60 μm long. Middle and hind legs with following numbers of pseudospurs on ta_{1+3} respectively: 4–9 plus 0–2 apical, 0, 0 (P_2); 6–8 plus 2

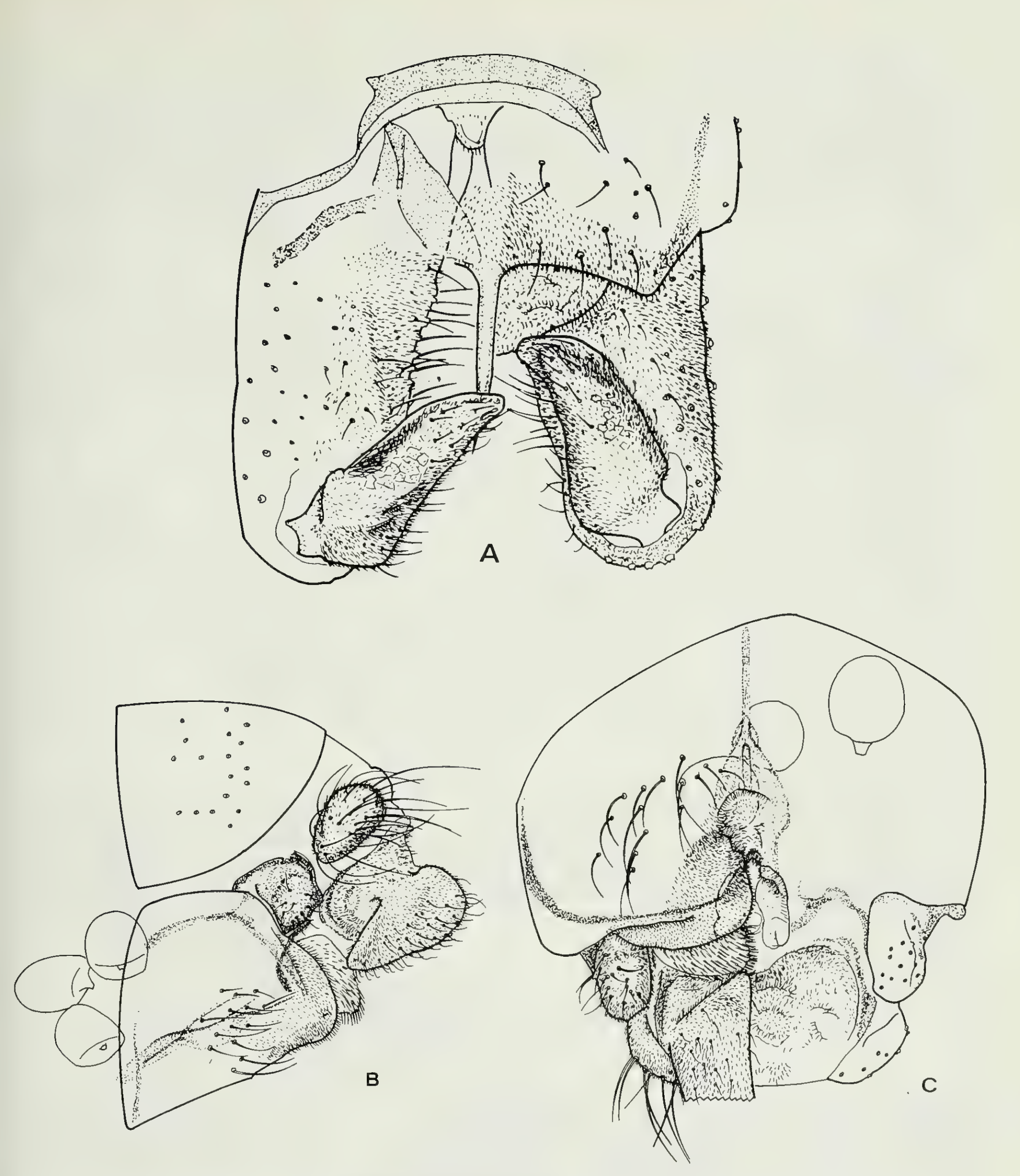


Fig. 1. *Lappodiamesa vidua* (Kieffer) comb. nov., imago. – A. Male hypopygium. – B–C. Female genitalia, lateral (B) and ventral (C) view (cerci damaged).

apical, 0, 0 (P_3). Front and middle ta_1 without sensilla chaetica; hind ta_1 with 18 sensilla chaetica distributed from 0.29–0.39 to 0.83–0.88. Lengths (μm) and proportions of legs:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
P_1	926- 973	1106-1181	728-751	383 (1)	236 (1)	161 (1)	137 (1)	0.64-0.66	3.17 (1)	2.79-2.87	2.6 (1)
P_2	1096-1143	1001-1158	576-595	293-321	208-217	132	113-123	0.51-0.52	3.65-3.72	3.81-3.87	2.9 (1)
P_3	1247	1351-1427	756-832	389-444	265-288	142 (1)	142 (1)	0.56-0.58	3.59 (1)	3.22-3.44	2.2 (1)

Genitalia (Figs 1 B–C): Sternite VIII with a total of 28–49 setae in a more or less contiguous distribution; gonocoxapodeme strongly sclerotized. Seminal capsules rounded, 98–132 μm long inclusive 19–23 μm long neck, width 79–86 μm; surface with possible indication of scattered, tubercle-like microtrichia. Notum 109–120 μm long, rami long and curved towards midline. Flap (WILLASSEN, 1982) poorly developed. Ventrolateral lobe large with dense lanceolate microtrichia. Apodeme lobe ill-defined. Gonocoxite rounded with 15–16 setae. Tergite IX clearly divided with a total of 35–50 setae.

Remarks

Kieffer based his original description on two males and one female collected by Dr. Økland on Novaja Semlja. According to KIEFFER (1922: 24) one male and the female were collected on 10th August and labelled No. 239. The second male was collected 23th August and was labelled No. 258. After completing his first description of *Syndiamesa vidua*, Kieffer received a second batch of specimens which he published on later (see KIEFFER, 1923: 4, 11): two males plus one female collected on 19th August, labelled No. 239, and three females with No. 228 and collection date 17th August.

We have studied one male and two females which according to the labels seem to belong to the second batch of KIEFFERS specimens. However, they are all labelled "Types" and the male carries two additional labels: one reading "*Diamesa vidua*" det. D. R. Oliver, the other "lectotypus det. D. R. Oliver". According to curator Mr. J. E. Raastad (personal communication to E. W.) four males (No. 239, 19th August) and one female (No. 228, 17th August) in addition to the ones examined here remain in Museum of Oslo, and he indicates that "10th August" is an error which should read "19th August". Unfortunately, this does not seem to solve the problem of authenticity satisfactory and thus our question of the validity of the lectotype-designation remains open. Nevertheless, based on the available specimens and the detailed description of SERRA-TOSIO (1968) it seems clear that *Lappodiamesa brundini* is a synonym of *S. vidua*.

Material studied

Lectotype, male: *Diamesa vidua* (Kieffer) (D. R. Oliver det.) USSR: Novaj. Semlja, Ökland leg., Pankratjef Peninsula, 19. Aug. No. 239, (with additional numbers: Gl 2772 and 12463); Litselustina Bay, 17. Aug., No. 228 (with additional numbers 12461 and 12462), 2 females; in coll. Mus. Zool., Oslo. Chukotka, Chegitun River, 4. Aug. 1981, E. Makarchenko, 2 male hypopygia, 3 pupal exuviae, 3 larvae; 8. Aug. 1981, 1 larva; in coll. Mus. Zool. Bergen.

Lappodiamesa boltoni spec. nov.
Figs 2–4

Type locality: USA, Ohio, Franklin County, Sharon Woods Park.

Holotype: Pharate male pupa labeled: USA, Oh., Franklin Co. Sharon Woods Pk, 3/25/86, leg. M. J. Bolton, ZMBN No. 114.

Paratypes: 5 males, 2 females, 1 pharate female pupa with associated larval exuviae, 4 pupal exuviae, 1 larva; as holotype. Types in coll. Museum of Zoology, University of Bergen, Norway.

Diagnosis

Female with 7 flagellomeres. Acrostichals absent. Wing punctated with microtrichia visible under 30× magnification, R_{2+3} ending in middle between R_1 and R_{4+5}, hind leg without distinct tibial comb, female with sensilla chaetica on ta_1 of all legs. Pupa without apical tubercle on anal lobe. Larva with first lateral teeth of mentum clearly narrower than median tooth.

Descriptions

Male imago (n = 5, unless otherwise stated)

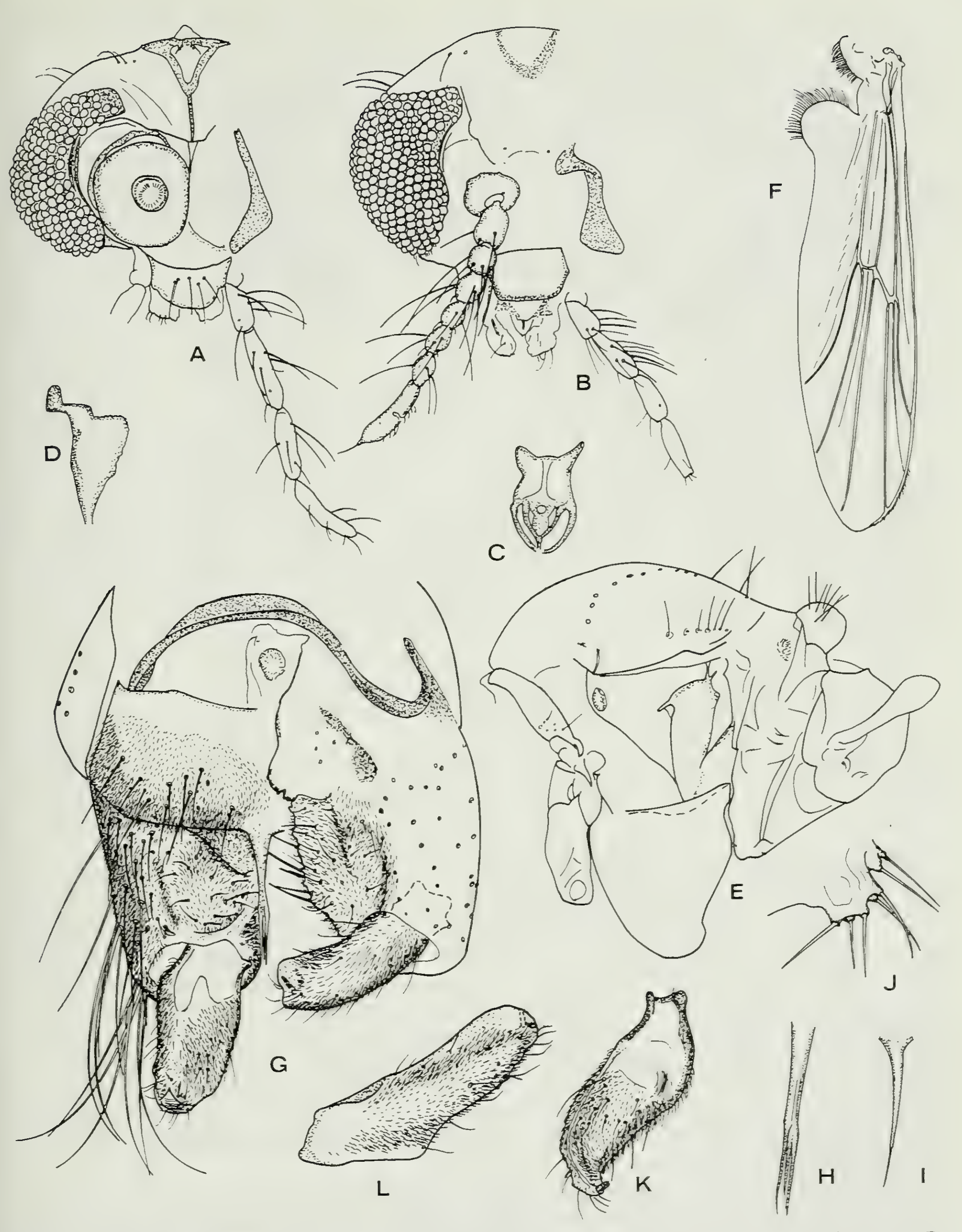


Fig. 2. *Lappodiamesa boltoni* spec. nov., imago. – A. Male head. – B. Female head. – C. Cibarial pump. – D. Stipes. – E. Thorax. – F. Male wing. – G–L. Male hypopygium with variation of anal point (H–I), details of superior volsella (J), and gonostyli (K–L).

Total length 4.37–4.82, 4.58 mm. Wing length 2.63–2.84, 2.69 mm. Total length/wing length 1.68–1.81, 1.72. Wing length/length of profemur 2.55–2.75, 2.65.

Head (Figs 2A, C–D): AR 2.32–2.53, 2.46. Ultimate flagellomere 732–860, 819 μm long. Coronal suture complete. Temporal setae 12–21, 15 (6) including 6–11 postorbitals, 3–6, 5 outer verticals and 1–5, 3 inner verticals. Eyes pubescent (not hairy) between all ommatids. Clypeus with 0–8, 3 (6) setae. Palps with long setae, sensilla clavata not apparent. Palp segments length (μm): 38–43, 40; 90–113, 99; 150–169, 156; 116–137, 122; 124–154, 142. Tentorium 203–244, 231 μm long. Cibarial pump as in Fig. 2C. Stipes (Fig. 2D) length/width 158–188, 168/49–68, 57 μm.

Thorax (Fig. 2E): Antepronotum deeply notched; with 3–10, 6 lateral setae. Dorsocentrals 14–26, 17 (4); supraalars and acrostichals absent; prealars 4–11, 6; Scutellars 14–17 (2), more or less biserial.

Wing (Fig. 2F): VR 0.81–0.89, 0.84. Costa produced 94–113, 99 μm beyond R_{4+5}. R_{2+3} in middle between R_1 and R_{4+5}. Microtrichia of wing membrane visible under 30× magnification. Brachiolum with 1–2, 2 (4) delicate setae. R with 8–10, 9 setae; R_1 with 2–6, 4; R_{4+5} with 2–3, 2 setae. Squama with 22–55, 40 (6) setae. Subcosta with 3 sensilla campaniformia, R_1 with 1, R_{2+3} with 3 and R_{4+5} without sensilla campaniformia. Anal lobe with well developed projection.

Legs: Spur of front tibia 71–83, 77 (4) μm long; spurs of middle tibia 45–68, 54 and 44–49, 44 (4) μm; of hind tibia 64–68, 65 and 41–47, 43 (4) μm long. Width at apex of front tibia 53–73, 66 (6) μm; of middle tibia 60–71, 65 μm; of hind tibia 68–79, 74 μm. Apex of hind tibia with somewhat irregularly dispersed setae, but without distinct setal comb. Middle and hind legs with the following numbers of pseudospurs on ta_{1-2} respectively: 8–15, 11 plus 2 apical; 0–4, 2 plus 2 apical (P_2); 6–14, 11 plus 2 apical; 1–4, 3 plus 0–2 apical (P_3). Other tarsal segments without pseudospurs. Posterior ta_1 with 6–13, 10 sensilla chaetica distributed from 0.66–0.83, 0.77 to 0.93–0.95, 0.94. Pulvilli weak.

Lengths (μm) and proportions of legs:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
P_1	983-1049 1015	1210-1266 1249	888-945 910	369-397 384	255-284 267	142-161 148	104-123 113	0.72-0.75 0.73	3.32-3.64 3.49	2.39-2.53 2.49	3.0-4.4 3.9
P_2	1088-1134 1101	1134-1200 1164	633-661 647	279-302 294	208-217 213	123-132 128	98-113 106	0.54-0.58 0.56	3.87-4.03 3.94	3.41-3.66 3.50	2.7-4.0 3.1
P_3	1229-1380 1304	1436-1539 1500	805-841 814	416-444 428	265-321 289	142-175 158	104-118 112	0.52-0.56 0.54	3.60-3.77 3.67	3.32-3.66 3.44	4.6-5.2 4.9

Hypopygium (Figs 2G–L): Tergite IX with 20–30, 25 setae. Laterosternite with 8–14, 10 setae. Anal point (Figs 2G–I) 53–105 μm, (apparently broken in 3 of 6 specimens), slender with delicate apical hair sensillum or more stout with double to triple apical spines. Transverse sternapodeme approximately 95–150 μm wide, without oral projections. Aedeagal lobe broad, rhomboid to spatulate; phallapodeme well sclerotized, 101–180, 151 μm long; pars ventralis (Fig. 2G) small and knoblike. Gonocoxite 296–360, 338 μm long; basally with rounded, setigerous superior volsellae (Figs 2G, J); inferior volsellae weakly delineated. Gonostylus (Figs 2G, K–L) 150–210, 173 μm long; with well developed crista dorsalis, macroseta relatively short. HR 1.71–2.20, 1.97. HV 2.27–2.95, 2.67.

Female imago (n = 2)

Total length 5.06–5.39 mm. Wing length 2.86–2.94 mm. Total length/wing length 1.77–1.83. Wing length/length of profemur 3.46.

Head (Fig. 2B): Pedicel without setae. Length of flagellomeres (μm): 79–83, 45–53, 53–60, 45–53, 45–56, 49–62, 120–161; 7th flagellomere partially divided 45–68 μm from base. AR 0.32. Flagellomeres 1–6 with 1 pair of apical sensilla chaetica dorsally and 0–2 sensilla chaetica ventrally; ultimate flagellomere with 18 sensilla chaetica; ringed sensilla coeloconica absent. Ultimate flagellomere with 1–2 subapical setae. Coronal suture incomplete or faint. Temporal setae 6–7, including 2–3 postorbitals, 2 inner- and 2 outer verticals. Eyes with weak pubescence which is mostly concealed by overlying ommatid lenses. Clypeus with 0–4 setae. Palp segments length (μm): 41–45, 83–90,

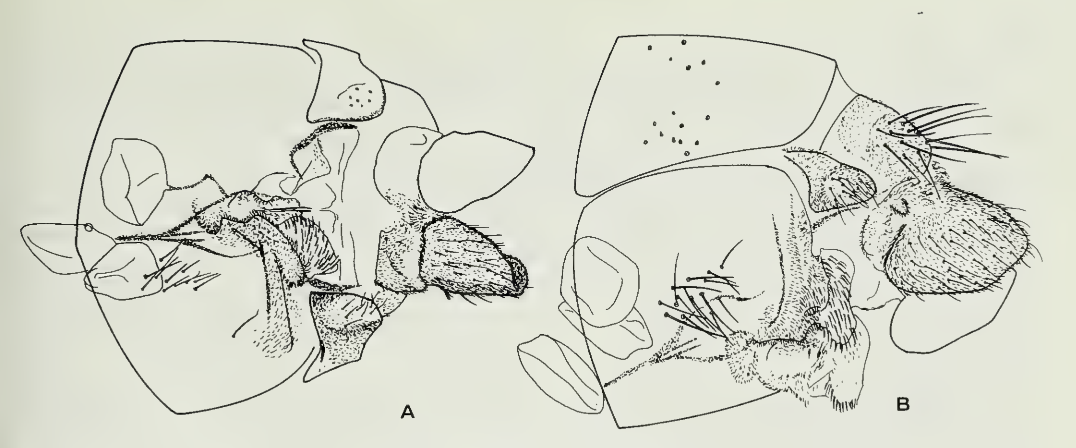


Fig. 3. *Lappodiamesa boltoni* spec. nov., female genitalia. — A. Ventral view. — B. Lateral view.

94–98, 83–90, 109–128; no sensilla clavata observed on palp. Tentorium 191 μm (1) long. Stipes length/width 154/71 μm.

Thorax: Antepronotum with 4–6 lateral setae. Dorsocentrals 16–17, supraalars and acrostichals absent, prealars 7. Scutellars 22–32, in biserial pattern.

Wing: VR 0.92–0.94. Costa produced 98–116 μm beyond R_{4+5}. Projection of anal lobe slightly less developed than in male. Microtrichia of wing membrane visible under 30× magnification. Brachiolum with 1–2 weak seta. R with 10–11 setae, R_1 with 5–7, R_{4+5} with 5–6 setae. Alula with 5 setae. Squama with 36–44 setae. Subcosta with 4 sensilla campaniformia, R_1 with 1, R_{2+3} with 3 and R_{4+5} without sensilla campaniformia.

Legs: Spur of front tibia 60–64 μm, spurs of middle tibia 45 μm and 49–56 μm, of hind tibia 45 μm and 60–64 μm long. Width at apex of front tibia 64 μm, of middle tibia 64–68 μm, of hind tibia 71–75 μm. Comb on hind tibia absent. Middle and hind legs with following numbers of pseudospurs on ta_{1-3} respectively: 7–10 plus 2 apical, 3–5 plus 2 apical, 0–1 (P_2); 7–8 plus 2 apical, 0–3 plus 0–2 apical, 0 (P_3). Front ta_1 with 4–9 sensilla chaetica distributed from 0.51–0.64 to 0.84–0.85; middle ta_1 with 17–21 sensilla chaetica from 0.23–0.38 to 0.86–0.91; hind ta_1 with 8–18 sensilla chaetica from 0.52–0.54 to 0.90–0.94.

Lengths (μm) and proportions of legs:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
P_1	827- 851	973-1002	628-643	260-284	180-194	118-132	104-113	0.64-0.65	3.45-3.67	2.86-2.88	2.0-2.1
P_2	983-1011	1044-1063	473-501	208-246	146-170	104-128	95-113	0.45-0.47	3.92-4.52	4.14-4.29	1.9-2.0
P_3	1096-1125	1257-1323	647-652	340	227-246	137-151	113-123	0.49-0.52	3.60-3.67	3.64-3.75	2.7

Genitalia (Figs 3 A–B): Sternite VIII with 12–16 setae to each side of midline; gonocoxapodeme narrow. Seminal capsules rounded, 139–154 μm long inclusive 8 μm long neck, width 113–128 μm; surface covered with dense, very fine microtrichia (500×) and scattered, tubercle-like microtrichia. Notum 94–101 μm long, rami long and curved towards midline. Flap (Willassen, 1982) poorly developed. Ventrolateral lobe large with dense lanceolate microtrichia. Apodeme lobe with microtrichia. Gonocoxite rounded with 14–16 setae. Tergite IX divided with 30–48 setae.

Pupa (n = 5, unless stated otherwise):

Total length 5.98–6.51, 6.20 mm. Exuviae brownish grey. Thorax rugulose. Abdomen with dark brown, strongly delineated apophyses.

Cephalothorax: Frontal apotome weakly rugose, without frontal warts or cephalic tubercles. Frontal setae 71–98, 80 μm long (4); postorbital seta 38–90, 58 μm long (4).

Median antepronotals 75–95, 86 μm and 41–68, 54 μm long; lateral antepronotal seta 75–90 μm long (3). Anterior precorneal seta 45–83, 68 μm long; median precorneal 79–98, 90 μm; posterior precorneal seta 49–68, 59 μm long. Distance between anterior and median precorneals 19–28, 26 μm; between median and posterior precorneals 23–56, 41 μm. Thoracic horn absent. Dorsocentral setae Dc_1 41–53, 41 μm long; Dc_2 23–56, 37 μm long; distance between Dc_1 and Dc_2 143–236, 189 μm. Metanotal seta (only one?) 15–38 μm long (3). Supraalar seta 23–26 μm long (3). Wing sheath nearly smooth.

Abdomen (Figs 4 A–B): Tergite I more or less bare, but reticulate; T II with weak median shagreen, T III–IX with anterior, median and more extensive posterior shagreen composed of slightly coarser spinules; conspicuous polygonous reticulation laterally. Sternites I and IX bare, S II–VIII with anteromedian shagreen. O-setae absent. Some tergal connectives with a few anteriorly directed spinules. T II–VII with 5 pairs of subequal, thin and simple D-setae. Segment I with 3 L-setae, segment II–VII with 4 ventral subequal, simple or bifid L-setae, L-setae of segment VIII displaced dorsomedially.

Anal lobe 488–525, 499 μm long (6); overreaching genital sac by 30–56 μm in male (2); 90–101, 94 μm in female, without apical tubercle. Length of anal macrosetae 289–308, 297 μm.

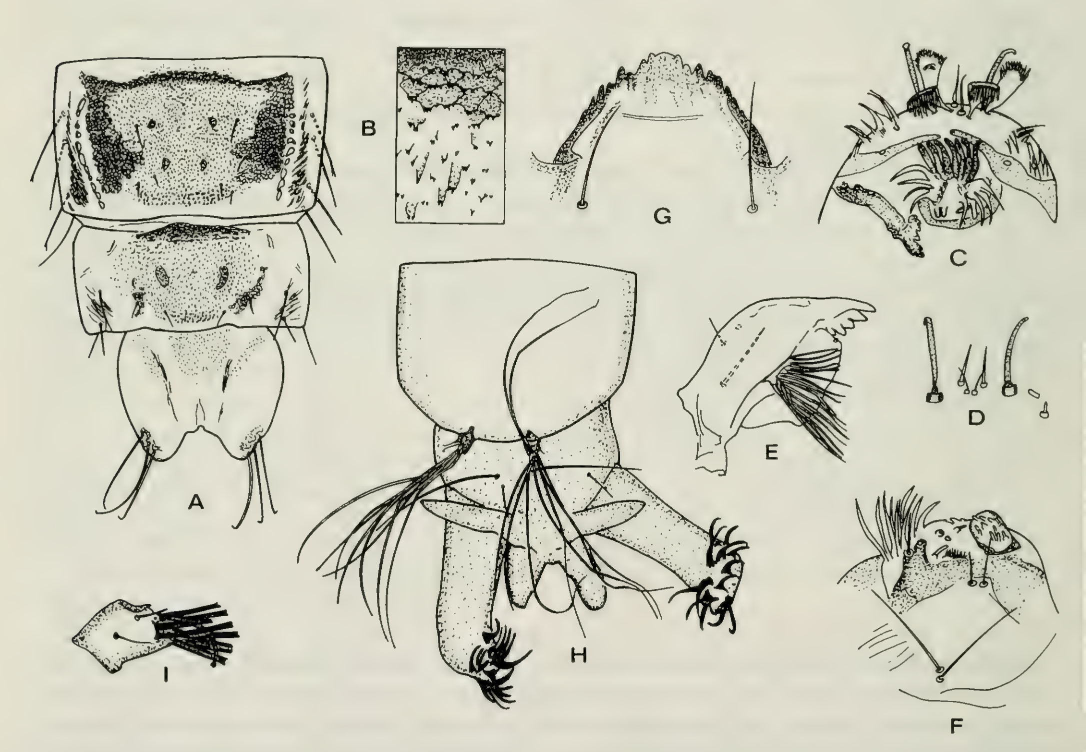


Fig. 4. *Lappodiamesa boltoni* spec. nov., immatures. – A–B. Pupa, tergites VII–IX (A) with detail of shagreen near apophysis (B). – C–I. Larva; labrum and epipharynx (C) with detail of S I – S IV (D), mandible (E), maxilla (F), mentum (G), posterior body segments (H) and detail of procercus (I).

Fourth instar larva (n = 3, unless stated otherwise):

Total length 8.96–9.92 mm. Head capsule length 0.44–0.52 mm.

Head: Antenna with 5 segments. Length of antennal segments (μm): 60–73, 17–22, 9–12, 3–4, 3–4. AR 1.74–1.85. Basal antennal segment 20–21 μm wide; distance from base to ring organ 13–20 μm, to basal mark of seta 17–34 μm, to distal mark 31–53 μm; blade 28–29 μm long, accessory blade 15 μm (1). Apical style of second segment 8–9 μm long. Third segment with about 7 annuli. Lengths of setae S 1–S 10 respectively (μm): 45 (1), 56 (2), 45, 75–105, 120–131, 86–120, 120–135, 158–184, 139–150. Labrum and epipharynx as in Figs. 4 C–D; labral lamella consisting of 2 pairs of pectinate lobes, each pair respectively with about 16–25 and 21–30 branches; S I simple and hairlike, S II (Fig. 4 D) stouter with scalelike base, S III very weak and simple, S IV a short and conelike with cuplike base, S I Vb small and digitiform without cuplike base; 14 simple chaetae, some very short, and 8 spinulae present. Pecten epipharyngis consisting of 7 elongate scales, chaetulae laterales 4, chaetulae basales 2. Premandibles (Fig. 4 C) 41–49 μm (2) long, with 5 teeth; lateral spine not apparent. Mandible (Fig. 4 E) 116–128 μm long, seta interna with 17–18 branches including 10 plumose branches; seta subdentalis short. Maxilla as in Fig. 4 F. Mentum (Fig. 4 G) with broad median tooth and 8 (9?) lateral teeth, first lateral teeth equally high as median tooth, but distinctly narrower.

Abdomen: Shorter claws of anterior parapods with 2–4 inner teeth. Body setae moderately long. Procercus 68–79 μm long, 45–53 μm wide; with 8–9 numbers of 533–555 μm long anal setae; lateral setae 49–56 μm long. Supraanal setae 338–356 μm long. Posterior parapods 469–488 μm long. Longest anal tubulus 248–281 μm long, 94 μm wide at base, 53–60 μm wide at middle.

Remarks:

The peculiar furcate anal point in two males of the material studied apparently is a dimorphism. The few males available appear to fall into two groups regarding the numbers of setae on the squama (52–55 and 22–30 respectively) and the HR ratio (1.71–1.88 and 2.00–2.20 respectively). The more normal-looking anal point is somewhat similar to those of *Pseudodiamesa* Goetghebuer and *Pseudokiefferiella parva* (Edwards), i. e with a delicate apical hair sensillum. The hypopygium is similar to *L. vidua* apparently differing only in the slightly more massive and less acute shape of the gonostyli, but the diagnostic characters will otherwise suffice to separate the two species.

The female genitalia of *L. boltoni* are quite "normal-looking". The pattern of microtrichia on the genitalia is somewhat similar to some *Potthastia* species. The microsculpture on the seminal capsules may be unique, and the presence of sensilla chaetica on the front leg will separate the species from all other known female Diamesinae.

The pupa differs most conspicuously from *L. vidua* by lacking apical tubercles on the anal lobe. Also, the L-setae are apparently much longer.

According to Makarchenko (1983) the labral sensillum S I is pectinate in the larva of *L. vidua.* Reexamination of his material, however, shows that he misidentified S I and that this structure actually belongs to the labral lamella, thus making both S I, S II and S III simple in this species, just like in *L. boltoni.* The scale at the base of S II both in *L. boltoni* and *L. vidua* is similar to that found on S II in *Pseudokiefferiella parva* and in the *Diamesa latitarsis* group (see Ferrarese & Rossaro, 1981: figs 15, 35). Reexamination of *L. vidua* also shows that this species has 7 scales in the pecten epipharyngis. The larva of *L. vidua* apparently differs from *L. boltoni* by having the first lateral teeth of the mentum about equally wide as the median tooth. The median tooth area, however, is highly variable and asymmetric in all the specimens.

Lappodiamesa was regarded as the sister group of *Diamesa* Meigen, *Sympotthastia* Pagast and *Potthastia* Kieffer combined by Serra-Tosio (1968). Later the genus was placed provisionally as the sister group of *Diamesa* (Serra-Tosio, 1973). The immature stages as well as the male imagines, however, will key out near *Pseudodiamesa* in the keys of Oliver (1983, 1986, 1988). A good synapomorphy for *Lappodiamesa* plus *Pseudodiamesa* appears to be the seven elongate scales of the pecten epipharyngis and we are convinced that *Lappodiamesa* at least belongs in the same group as *Pseudodiamesa* together

with *Arctodiamesa* Makarchenko, *Pagastia* Oliver, *Potthastia*, and *Sympotthastia*. The overall similarities of the larvae with *Pseudokiefferiella* Zavřel probably are symplesiomorphies.

Acknowledgement

We thank Mr. M. J. Bolton who provided the specimens of *L. boltoni*, Mr. J. E. Raastad for arranging a loan of putative types of *Syndiamesa vidua*, and Dr. E. A. Makarchenko who sent us additional specimens of *L. vidua* for comparison. Prof. emeritus H. Kauri spent some time revealing the contents of Russian text for us.

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Redescription of Paratrissocladius acuminatus (Edwards) comb. n. (= Cardiocladius acuminatus Edwards) from Southern Chile

(Diptera: Chironomidae)

By **Godtfred A. Halvorsen**

Abstract

The holotype of *Cardiocladius acuminatus* Edwards, 1931: 274, is redescribed and transferred to the emended genus *Paratrissocladius* Zavřel, 1937. The terminology of the chironomid wing venation is discussed and posterior cubitus – PCu, and second anal vein – An_2 is used instead of vannal fold and Ax-vein respectively.

Introduction

While revising the genera in the *Cardiocladius* group, the holotype of *Cardiocladius acuminatus* Edwards (1931: 274) from Southern Chile was examined. As mentioned by BRUNDIN (1956: 66) the presence of a stout anal point with setae suggests that the species does not belong in *Cardiocladius* Kieffer. Lacking knowledge of other stages than the male makes the generic placement of the species somewhat uncertain. However, the species will in recent keys (PINDER, 1978; OLIVER et. al. [MS]) key out to *Paratrissocladius* Zavřel, as defined by SÆTHER (1976: 253).

Morphology

The morphological terminology follows SÆTHER (1980) with some additions discussed below. Measurements and ratios follow SCHLEE (1966) with additions and modifications given by SÆTHER (1969, 1976).

The presence of a second anal vein (An_2) is a plesiomorphous character in the Diptera (HENNIG 1954, 1969). In the chironomids only the first anal vein (An_1) is well developed, while An_2 usually is strongly reduced. However, in several genera it is possible to trace remnants of the vein as often is indicated in the figures. EDWARDS (1929: 285, text to fig. 1; 317) used the term Ax-vein, and so did also BRUNDIN (1956: 24, fig. 5; 66). An_2 is especially well developed in *Cardiocladius* Kieffer and was used by Edwards as a diagnostic character for the genus. In BRUNDIN's (1956) figure of the wing of *C. capucinus* (Zetterstedt), An_2 is clearly forked with a stem, a short and weak anterior branch and a stronger posterior branch. This condition is present in all species of *Cardiocladius* I have examined, as well as in *Paratrissocladius acuminatus* (Fig. 1 C). However, it is not so clearly developed in the latter species. In other genera where An_2 is indicated, including the two other species of *Paratrissocladius,* it always appears unbranched. Edwards stated that when present, the Ax-vein was lying between two anal folds. According to WOTTON (1979: 88) and LINDEBERG (1983: 168) the anterior fold (a. f. 1 of Edwards) probably is the claval furrow, a flexion line which runs posterior to An_1 in the Diptera. Thus, the anterior branch of An_2 clearly present in *Cardiocladius* may be interpreted as this flexion line, lying very close to the true vein and appearing as a part of it.

Following LINDEBERG (1983) and WOTTON (1979) the term vannal fold as used by HANSEN & COOK (1976) and SÆTHER (1980) is erroneous, and posterior cubitus (PCu) has to be adopted in its place.

Systematics

EDWARDS (1931: 274) apparently placed *P. acuminatus* in *Cardiocladius* due to the presence of a cordiform ta_4. This character is at least not a good synapomorphy. BRUNDIN (1966: 363) made a review of the occurrence of a cordiform ta_4 in the Chironomidae, and he regarded the character as a plesiomorphy and a probable adaptation to a life in strong currents. Furthermore, the degree of cordiformity varies inside *Cardiocladius. C. capucinus* (Zetterstedt) has for instance an almost cylindrical ta_4 at least on the front leg, slightly shorter than ta_5 only, while other species in the genus have a more or less distinctly cordiform ta_4. In addition, ta_4 of *P. acuminatus* is slightly different from that in *Cardiocladius* in that it is stronger produced beneath the base of ta_5. These different types of cordiformity are also found inside the Diamesinae (WILLASSEN, pers. com.), and may be interpreted as different trends. However, the tendency to get a cordiform ta_4 can be interpreted as an underlying synapomorphy inside the Orthocladiinae. SÆTHER (1977: 86), Sæther & Halvorsen (1981: 283) and Sæther (1983 a: 284) indicates that the sistergroup of the *Cardiocladius* group is the *Heterotrissocladius* group, and that the *Parakiefferiella* group is the sistergroup of these two combined. The tendency to get a cordiform ta_4, interpreted as an underlying synapomorphy, would support the hypothesis of these genus groups being a monophyletic unit, possibly including *Psilometriocnemus* Sæther, and with one parallel development only, the *Corynoneura* group.

One of the reasons for transferring the species to *Paratrissocladius* is the shape of the anal point. SÆTHER (1983 b: 355) made a phylogenetic analysis of the anal points in the *Heterotrissocladius* group, stating that his Type 1 present in all species of *Paratrissocladius* and *Heterotrissocladius*, and in some species of *Parametriocnemus* Goetghebuer and *Paraphaenocladius* Thienemann, was unique. This Type 1 anal point is present in *P. acuminatus* also, and is regarded as an underlying synapomorphy for the *Heterotrissocladius* group.

SÆTHER (1975: 62) regarded the presence of strong microtrichia only on the wing membrane as a synapomorphy for *Paratrissocladius*, and the presence of both microtrichia and setae as the plesiomorphous character alternative for the rest of the *Heterotrissocladius* group. The situation in the *Cardiocladius* group where the microtrichia are very weak, may be seen as the apomorphous alternative in a three step trend, and exclude *P. acuminatus* from being a member of that group.

The presence of a virga consisting of a group of minute spines also shows affinity with the *Heterotrissocladius* group. This is Type 5 in SÆTHER (1983 b: 356) and is also found in some *Paraphaenocladius*. SÆTHER (1976: 253) states that the spines of the penis cavity in *Paratrissocladius* apparently are very small. Only *Tokunagaia* Sæther and *Tvetenia* Kieffer possess virga in the *Cardiocladius* group, the first one has Type 4, the latter one a derivation of Type 4 which possibly is a sixth type of virga in the orthoclads.

The presence of tarsal pseudospurs may indicate a closer relationship with the *Cardiocladius* group. These are absent in the *Heterotrissocladius* group, but present in the *Cardiocladius* group except in the *Eukiefferiella claripennis* and *coerulescens* groups, in *Dratnalia* Sæther & Halvorsen, and in *Tvetenia* where they are both present and absent.

The strong *Parakiefferiella*-like bend of the gonostylus is unique for *P. acuminatus*. However, an indication of a bend is at least present in *P. natalensis* (Freeman). Until additional knowledge of the other stages of *P. acuminatus* is available, the species can best be placed in *Paratrissocladius*.

Diagnosis

The following corrections and emendations have to be included in the diagnosis given by SÆTHER (1976: 253):

Eye scarcely to moderately elongated dorsally. Flagellomere 2 and 3, or 2–6 with sensilla chaetica. Dorsocentrals numerous to normal, with or without humerals. Acrostichals numerous to few. An_2 distinct. ta_4 cylindrical or cordiform. Pseudospurs absent or present. Sensilla chaetica present on mid or hind legs. Anterior margin of transverse sternapodeme convex or straight. Virga present as a small cluster of minute spines. Gonostylus with more or less *Parakiefferiella*-like bend.

Paratrissocladius acuminatus (Edwards) comb. nov.
Fig. 1 A–E

Cardiocladius acuminatus Edwards 1931: 274, male described.

The male is characterized by an AR of 1.40; eyes scarcely elongated dorsally; 6 temporal setae; ta_4 cordiform; pseudospurs present; sensilla chaetica on mid ta_1 only; humerals absent; gonostylus with marked bend.

Male imago (n = 1)

Total length 3.67 mm. Wing length 2.23 mm. Total length/wing length 1.65. Wing length/length of profemur 2.72.

Antenna: (Fig. 1 A) Flagellum with 13 flagellomeres, last flagellomere 534 μm long. AR 1.40.

Head: (Fig. 1 B) Temporal setae 6, including 1 inner vertical, 1 outer vertical, and 4 postorbitals. Clypeus with 8 setae. Tentorium 183 μm long, 28 μm wide at sieve pore. Stipes 151 μm long, 50 μm wide. Palp missing.

Thorax: (Fig. 1 C) Antepronotum with 11 setae. Dorsocentrals 16; acrostichals 5 (some probably lost in preparation); prealars 4. Scutellum with 7 setae.

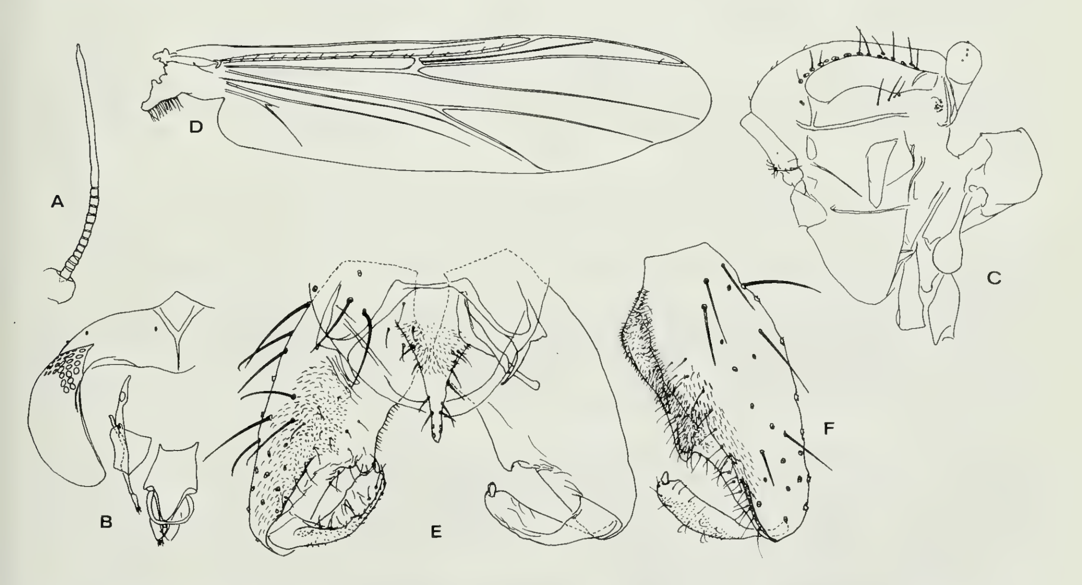


Fig. 1. *Paratrissocladius acuminatus* (Edwards) comb. n.; A – antenna; B – head; C – thorax; D – wing; E – male hypopygium, dorsal view; F – male hypopygium, ventral view.

Wing: (Fig. 1 D) Anal lobe well developed. R_{2+3} ending slightly before the middle of the distance between R_1 and R_{4+5}. VR 1.13. Brachiolum with 2 setae; R with 14 setae; R_1 with 5 setae; and R_{4+5} with 1 seta. Squama with 16 setae.

Legs: Spur on front tibia 65 μm long. Spurs on mid tibia 48 μm and 33 μm long; on hind tibia 65 μm and 38 μm long. Width at apex of front tibia 50 μm; of mid tibia 45 μm; and of hind tibia 50 μm. Comb on hind tibia with 10 setae; longest seta 40 μm long; shortest seta 23 μm long. Mid leg with 2 pseudospurs on ta_1 and ta_2, and 1 on ta_3; hind leg with 2 on each. Mid leg with 10 sensilla chaetica apically on ta_1; hind leg without. Leg lengths (micrometers):

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
P_1	819	1051	859	440	252	78	88	0.82	3.18	2.18	2.3
P_2	890	971	516	272	138	55	88	0.53	4.30	3.61	2.2
P_3	950	1183	748	390	163	60	95	0.63	4.07	2.85	---

Abdomen: Setae on tergites numerous, more or less uniformly scattered. Sternites 5–8 with median patches of large setae in addition to lateral lines with weaker setae.

Hypopygium: (Figs. 1 E, F) Ninth tergite with 27 setae, including setae on anal point; laterosternite with 7 setae. Phallapodeme 110 μm long. Transverse sternapodeme 68 μm long. Gonocoxite 282 μm long; gonostylus 124 μm long. HR 2.28. HV 2.96.

Female, Pupa and Larva unknown.

Material examined and distribution: Holotype, male, slide labelled "*Cardiocladius acuminatus* Edw., F. W. Edwards det. 1931, Peulla: 12–13. XII. 1926, Southern Chile: Llanquihue Prov., F. & M. Edwards., B. M. 1927–63". (In the British Museum.) The species is known from the type locality only. This is the first record, of the genus from South America.

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Description de trois femelles de Diamesa Meigen dont D. cinerella Meigen (Lectotype et Paralectotype)

(Diptera, Chironomidae)

Par **Endre Willassen** et **Bernard Serra-Tosio**

Abstract

A lectotype has been selected and a full description is given of the types of the genus *Diamesa: D. cinerella* Meigen, 1835. Examination of the types confirms that our present concept of the genus is correct. The female of *D. kasymovi* Kownacki & Kownacka is described for the first time and the female of *D. dampfi* (Kieffer) is redescribed.

Introduction

Au cours des ans, une considérable confusion de nomenclature a régné dans la littérature consacrée aux chironomides à propos de la date de création du genre *Diamesa* et de son auteur. Les causes de cette confusion sont multiples. Certaines d'entre elles ont été passées en revue par Hansen & Cook (1976) et par Ashe (1982). Il semble maintenant évident que la première description valide du genre *Diamesa* doit être mise au crédit de Meigen (in Gistl, 1835) (cf. Freeman & Cranston, 1980) et que *Diamesa cinerella* est le type de genre par monotypie originale. La description postérieure de *D. cinerella* par Meigen (in Waltl, 1837) n'était évidemment qu'une simple répétition de la description originale (comme l'indiquait le sous-titre de l'article: „Aus dem ‚Faunus' von Gistl"). Meigen considérait les spécimens examinés comme des mâles, mais on peut émettre quelque doute sur cette opinion quand on lit sous sa plume: „Verdient genauere Beobachtung, besonders des Geschlechtsunterschiedes wegen" (in Gistl, p. 67).

Plus tard, et pour des raisons inconnues, Meigen (1838) rebaptise tout simplement l'espèce *Diamesa waltlii.* Il est très probable que la description de *D. waltlii* est basée sur les mêmes spécimens qui avaient été antérieurement appelés *D. cinerella* (Bergroth, 1887; Hansen & Cook, 1976).

Goetghebuer (1923) examina les types de *D. waltlii* et constata qu'il s'agissait de femelles qu'il associa de façon erronée avec les mâles de *Tanypus praecox* Meigen (= *Prodiamesa olivacea* [Meigen]). Par voie de conséquence, il déclara que le quatrième article du tarse de l'espèce était cylindrique. Plus tard cependant (Goetghebuer, 1932), il considéra *D. waltlii* comme une espèce valide et fit une courte description du mâle et de la femelle. En même temps, il ne donnait aucune référence sur la synonymie antérieure de *D. waltlii* avec *T. praecox* et décrivait le quatrième article du tarse comme cordiforme.

Pagast (1947), qui fit la première grande révision des *Diamesa* et genres voisins, supprima le nom *D. waltlii* et le remplaça pour des raisons de priorité par *D. cinerella.* Cependant, comme les types du genre *Diamesa* étaient des femelles, il s'abstint apparemment de les examiner, de sorte qu'il n'est pas sûr que le concept actuel du genre *Diamesa* corresponde à l'identité des types (Hansen & Cook, 1976). Sur la base d'une étude comparée des imagos femelles de *Diamesa* faite par l'un de nous (Willassen, 1982), nous estimons que le moment est venu de réexaminer le type du genre et d'en présenter une description détaillée. En même temps, nous en profitons pour décrire les femelles, inconnues jusqu'ici, de

Diamesa kasymovi Kownacki & Kownacka et de *D. dampfi* (Kieffer), cette dernière espèce étant impossible à identifier d'après sa description originale.

Diamesa cinerella Meigen
(Fig. 1)

Diamesa cinerella Meigen in GISTL, 1835: 66; MEIGEN in WALTL, 1837: 283–284 (description de la femelle).
Diamesa waltlii Meigen, 1838: 13 (femelle).
? *Diamesa cinerella* Meigen: PAGAST, 1947: 482–484 (description du mâle).

Imago mâle

Cf. SERRA-TOSIO, 1971.

Imago femelle (lectotype)

Diagnose

Antenne avec dorsalement une sensille coeloconique à microtriches sur les flagellomères 1 et 2. Flagellomère 7 avec 1 à 2 soies préapicales et 2 soies apicales. Yeux à pubescence longue. Ta_4 de chaque patte cordiforme. Capsules spermathécales de taille moyenne, au nombre de deux. Gonapophyse VIII avec un pan («flap» de Willassen, 1982) recourbé ventralement. Gonocoxite en forme de plaque convexe et plus ou moins triangulaire. Tergite IX avec deux plaques arrondies. Segment X avec, en vue ventrale, un tubercule digitiforme.

Description

Longueur/largeur de l'aile: 5,20/2,06 mm. Longueur de l'aile/longueur du fémur antérieur: 3,04.

Antenne: scape sans soies. Pédicelle avec 2 soies. Flagellomères 1 à 6 avec respectivement le nombre de soies suivant: 6, 5, 6, 4, 4, 1. Dernier flagellomère avec 1 à 2 soies préapicales et 2 soies apicales. Longueur maximale des soies antennaires: 147 μm. Longueur/largeur du pédicelle: 72/120 μm. Longueur/largeur des flagellomères 1 à 7: 112/49, 68/41, 68/41, 52/38, 49/41, 41/34, 196/45 μm. AR 0,46. Une sensille coeloconique à microtriches dorsalement sur chaque flagellomère 1 et 2.

Tête: suture coronale ne dépassant pas le niveau des sensilles frontales. Sensilles frontales à 132 μm l'une de l'autre, et chacune à environ 40 μm de l'apex de la protubérance frontale. Protubérances frontales bien saillantes. Soies temporales: 43 au total, dont 1 soie frontale et 11 soies postorbitales. Microtriches oculaires denses, dépassant très largement les facettes latérales. Clypéus avec 15 soies. Longueur/largeur du clypéus: 135/233 μm. Longueur/largeur des articles du palpe: 38/56, 105/64, 169/72, 177/45, 252/45 μm. «Palpal stoutness» (Hansen & Cook 1976) (= rapport longueur du palpe à partir de l'article 2 sur somme des largeurs des articles 2 à 5): 3,11. Tentorium avec un processus antérolatéral bien marqué.

Thorax: antépronotum dépassant un peu la protubérance scutale, avec 21 soies pronotales latérales. Soies acrosticales absentes. 17 à 18 soies dorsocentrales. 13 à 14 soies préalaires disposées sur 1 à 3 rangs. Protubérance de l'épiméron avec 4 soies. Préépisternum sans soies. 50 soies scutellaires.

Aile: coloration brunâtre. VR 0,96. R_1 peu arquée, faiblement recourbée vers l'avant et prolongée du côté distal, presque parallèle à la costa à partir de son milieu. RM bien courbée. R_{4+5} arquée. Microtriches de la membrane alaire visibles dès le grossissement 30×. Brachiolum avec 3 soies distales et 1 soie basale. R avec 19 soies, R_1 avec 20 soies, R_{2+3} sans soies, R_{4+5} avec 20 soies et RM avec 0 à 1 soie. Alula avec 12 soies. Squame avec environ 70 soies. Sensilles campaniformes: 4 sur Sc, 2 sur R_1, 2 sur R_{2+3}, 4 sur R_{4+5}.

Pattes: éperons des tibias: 64 μm (P_1); 68 et 64 μm (P_2); 109 et 72 μm (P_3). Largeur de l'extrémité du tibia de P_1 à P_3 respectivement: 98, 90, 117 μm. Peigne du tibia de P_3 avec 19 soies (45 à 87 μm). 2 soies spiniformes apicales sur seulement chacun des deux premiers articles de chaque tarse. Soies spiniformes préapicales des tarses: 4,0,0 (P_1); 18,9,4 (P_2); 26,8,4 (P_3). Sensilles chétiformes: environ 220

disposées sur 1 à 3 rangs depuis le 0,06 jusqu'au 0,61 du métatarse de P_3. Pattes à 4e article du tarse cordiforme (cf. Fig. 2.3). Pulvilles petites, visibles au grossissement 300×.

Longueurs (en μm) et proportions des articles des pattes:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
P_1	1710	1971	1140	624	422	163	172	0.58	3.49	3.23	1.3
P_2	1971	1781	760	451	307	154	181	0.43	4.12	4.94	1.8
P_3	2018	2256	1235	784	428	144	182	0.55	3.58	3.46	2.0

Hypopyge (Fig. 1): sternite VIII avec de chaque côté 17 à 20 soies. Gonocoxapodème distinct, fortement courbé en vue ventrale. Pan (= «flap») recourbé ventralement, formant de la sorte, en vue ventrale, une saillie arquée à l'avant du lobe ventrolatéral. Capsules séminales de taille moyenne, avec une ponctuation superficielle visible dès le grossissement 300×. Conduits séminaux de longueur moyenne. Gonocoxite en forme de plaque convexe et plus ou moins triangulaire, à partie moyenne faiblement protubérante; 17 soies sur chaque gonocoxite. Tergite IX avec deux plaques arrondies, complètement séparées l'une de l'autre; chacune avec à peu près 25 soies longues. Partie postérolatérale du segment X avec, en vue ventrale, un tubercule digitiforme dirigé vers l'arrière. Cerques prolongés ventralement, à face latérale un peu plissée.



Fig. 1. *Diamesa cinerella* Meigen (lectotype), femelle; hypopyge en vue latérale.

Nymphe

Cf. Serra-Tosio, 1971; Ferrarese & Rossaro, 1981.

Larve

Cf. Rossaro, 1980; Ferrarese & Rossaro, 1981.

Remarque

L'affirmation par Goetghebuer (1923) que Ta_4 a une forme cylindrique est erronée. La morphologie de la femelle décrite ci-dessus confirme l'appartenance réelle du type de genre au genre *Diamesa* tel que nous le concevons actuellement. D'ailleurs le pan recourbé de la gonapophyse et la saillie digitiforme du segment X montrent que cette espèce appartient au groupe *cinerella*. Cette appartenance était à l'origine fondée sur des caractères du mâle et de la nymphe (Serra-Tosio, 1971). Le groupe *cinerella* est donc facile aussi à caractériser grâce aux génitalia femelles (Willassen, 1982). Mais malgré le large éventail de variation des caractères distinctifs spécifiques constaté à l'intérieur du groupe, on n'est pas parvenu jusqu'à présent à des résultats probants pour l'identification des espèces en utilisant les imagos femelles. Il est pourtant intéressant de noter que le gonocoxite possède une ébauche de saillie arrondie du côté médian. Il est possible que cette caractéristique soit sujette à variation, puisque cette saillie est moins apparente chez les spécimens supposés appartenir à l'espèce *D. cinerella*. Une saillie arrondie assez développée se rencontre chez *Diamesa lavillei* Serra-Tosio et ce caractère a été utilisé par Willassen (1982) pour séparer cette espèce des autres femelles du groupe *cinerella*. Bien que l'espèce *D. cinerella* ait été associée avec le mâle décrit par Pagast (1947) et par des auteurs ultérieurs, il n'y a pas jusqu'à présent de preuves évidentes d'une telle association.

Répartition

Massifs montagneux d'Europe moyenne (arc alpin, Forêt Noire, Massif Central, Pyrénées) (Serra-Tosio, 1971).

Matériel examiné

Lectotype et paralectotype (par désignation actuelle) femelles en préparations au baume du Canada, portant des étiquettes à texte original suivant: Diamesa waltli, Meigen (et derrière la même étiquette le numéro 267/40), Muséum National d'Histoire Naturelle, Paris, France, No 133.

Diamesa kasymovi Kownacki & Kownacka (Fig. 2.1–6)

Diamesa kasymovi Kownacki & Kownacka, 1973: 32–36 (description du mâle, de la nymphe et de la larve).

Imago mâle

Cf. Kownacki & Kownacka, 1973.

Compléments à la description originale: dans la publication de Kownacki & Kownacka (1973), la tête du mâle de *D. kasymovi* est dessinée fig. 8. L'antenne y est représentée avec 9 flagellomères, donc 10 articles apparents si l'on compte le pédicelle, alors que le texte correspondant indique 9 articles, c'est-à-dire le pédicelle plus 8 flagellomères (come *D. sakartvella* décrit par les mêmes auteurs dans la même publication). Nous avons examiné un spécimen mâle de *D. kasymovi* provenant du Caucase et aussi plusieurs spécimens de la Turquie et du Liban. Nous avons pu constater qu'une des antennes de quelques spécimens comptait bien 8 flagellomères, mais l'autre 7 seulement. Nous estimons cependant que le nombre normal d'articles du flagelle antennaire de *D. kasymovi* doit être de 8. La figure de Kownacki & Kownacka est donc erronée, comme nous l'a confirmé A. Kownacki in litt.

Dans la même publication, Kownacki & Kownacka représentent l'hypopyge mâle de *D. kasymovi* (fig. 9) avec de longues soies dorsales sur la partie proximale de l'appendice du coxite. En fait ces soies (correspondant au «basimedial setal cluster» de Hansen & Cook, 1976) sont ventrales et portées par un tubercule, ce que nous a confirmé aussi A. Kownacki (in litt.).

Imago femelle

Diagnose: cf. *D. cinerella*



Fig. 2.1–6. *Diamesa kasymovi* Kownacki & Kownacka, femelle. 2.1 aile, 2.2–3 Ta_4 des pattes en vue latérale et en vue dorsale, 2.4 hypopyge en vue latérale, 2.5 lobe ventrolatéral en vue ventrale, 2.6 hypopyge en vue ventrale.

Description (n = 1 à 5)

Longueur totale: 4,00 mm. Longueur/largeur de l'aile: 3,00/1,17 mm. Longueur totale/longueur de l'aile: 1,33. Longueur totale/longueur du fémur antérieur: 2,27.

Antenne: scape sans soies. Pédicelle avec 3 soies. Flagellomères 1 à 6 avec respectivement le nombre de soies suivant: 4, 4, 4, 2, 4, 1. Dernier flagellomère avec 1 soie préapicale et 2 soies apicales. Longueur maximale des soies antennaires: 98 μm. Longueuer/largeur du pédicelle: 64/94 μm. Longueur/largeur des flagellomères 1 à 7: 98/42, 49/33, 51/29, 43/25, 43/29, 25/23, 130/29 μm. AR 0,42. Une sensille coeloconique à microtriches dorsalement sur chaque flagellomère 1 et 2. Remarque: chez le spécimen décrit, le flagellomère 6 est incomplètement séparé du flagellomère 7; chez les autres spécimens examinés, les flagellomères 6 et 7 sont au contraire bien séparés; le coefficient AR reste dans tous les cas à peu près le même.

Tête: suture coronale complète. Sensilles frontales à 90 μm l'une de l'autre, et chacune environ 35 μm de l'apex de la protubérance frontale. Protubérances frontales aplaties, peu saillantes. Soies temporales: 33 à 36 au total (dont 1 à 2 soies frontales et 7 à 8 soies postorbitales). Microtriches oculaires denses, dépassant très largement les facettes latérales. Clypéus avec 5 soies. Longueur/largeur du clypéus: 140/160 μm. Longueur/largeur des articles du palpe: 39/60, 95/54, 125/49, 130/39, 230/35 μm. «Palpal stoutness» (Hansen & Cook, 1976): 3,47. Tentorium avec un processus antérolatéral peu marqué.

Thorax (n = 5): antépronotum dépassant un peu la protubérance scutale, avec 10 à 21 soies pronotales latérales. Soies acrosticales absentes. 13 à 17 soies dorsocentrales, disposées sur 1 à 2 rangs en avant et en arrière. 8 à 12 soies préalaires disposées sur 1 à 2 rangs.Pas de soies supraalaires. Protubérance de l'épiméron avec 8 à 15 soies. Préépisternum sans soies. 34 à 68 soies scutellaires.

Aile (Fig. 2.1): coloration brunâtre clair. VR 0,91. R_1 arquée, faiblement recourbée vers l'avant et prolongée du côté distal, rapprochée de la costa et presque parallèle à elle à partir de son milieu. RM fortement courbée. Microtriches de la membrane alaire visibles dès le grossissement 50×. Brachiolum avec 3 soies distales, 1 soie médiane et 1 forte soie basale. R avec 20 soies, R_1 avec 19 soies, R_{4+5} avec 22 soies. RM sans soies. Alula avec 7 soies. Squame avec 37 soies. Sensilles campaniformes: 2–3 sur Sc, 2 sur R_1, 1 à 3 sur R_{2+3}, 4 à 6 sur R_{4+5}.

Pattes (Fig. 2.2–3): éperons des tibias: 52 µm (P_1); 46 et 56 µm (P_2); 58 et 90 µm (P_3). Peigne du tibia de P_3 avec 16 soies (68 à 83 µm). 2 soies spiniformes apicales sur seulement chacun des deux premiers articles de chaque tarse. Soies spiniformes préapicales des tarses: 0,0,0 (P_1); 11,4,0 (P_2); 17,6,0 (P_3). Sensilles chétiformes: environ 235 réparties depuis le 0.06 jusqu'au 0.63 (soit environ les 2/3) du métatarse de P_3. Pattes à 4e article du tarse cordiforme (Fig. 2.2–3). Pulvilles petites, visibles au grossissement 350×.

Longueurs (en µm) et proportions des articles des pattes:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
P_1	1320	1465	1055	450	295	110	150	0.72	3.82	2.64	1.7
P_2	1370	1335	625	320	200	110	140	0.47	4.32	4.33	1.9
P_3	1615	1690	1100	595	295	115	150	0.65	3.81	3.00	1.8

Hypopyge (Fig. 2.4–6) (n = 5): sternite VIII avec de chaque côté 16 à 28 soies. Gonocoxapodème distinct, fortement courbé en vue ventrale. Pan (= «flap») recourbé ventralement, formant de la sorte, en vue ventrale, une saillie arquée en avant du lobe ventrolatéral. Capsules séminales de taille moyenne, à ponctuation superficielle visible dès le grossissement 300×. Conduits séminaux de longueur moyenne. Gonocoxite en forme de plaque convexe et plus ou moins triangulaire, partie moyenne avec une petite protubérance arrondie; 16 à 23 soies sur chaque gonocoxite. Tergite IX avec deux plaques arrondies, complètement séparées l'une de l'autre; chaque plaque porte 16 à 29 soies longues. Partie postérolatérale du segment X avec, en vue ventrale, un tubercule digitiforme dirigé vers l'arrière. Cerques prolongés ventralement, à face latérale un peu plissée.

Remarque

La femelle de *Diamesa kasymovi*, dont c'est ici la première description, est très semblable aux femelles de la plupart des espèces du groupe *cinerella* (sauf *D. lavillei* Serra-Tosio).

Le faible nombre d'exemplaires de *D. kasymovi* disponibles présente un nombre significativement plus élevé (U-Test de Mann-Whitney) de soies sur le sternite VIII que les femelles appartenant probablement à l'espèce *D. tonsa* (Haliday) provenant de Turquie. Cependant l'analyse statistique des caractères dans le groupe *cinerella* est actuellement basée sur des données incomplètes, et on ne sait pas si le nombre de soies sur le sternite VIII peut être utilisé comme caractère général pour séparer les femelles de *D. kasymovi* et celles de *D. tonsa*.

Répartition

Versants asiatique et européen du Caucase (Kownacki & Kownacka, 1973, 1974), Liban (Moubayed & Laville, 1983), Turquie (Reiss, 1985).

Matériel examiné

Liban: Mont Liban, 1100 à 1450 m; leg. Z. Moubayed, 1981 et 1982; 7 mâles, 9 femelles, 2 nymphes femelles; coll. B. Serra-Tosio, Grenoble, France. Turquie: Prov. Rize, Ovit-Paß, südlich Ikizdere; 2600 m; leg. W. Schacht; 10.7.1986; 4 mâles, Zoologische Staatssammlung, Munich, R. F. A.

Diamesa dampfi (Kieffer)
(Fig. 3.1–6)

Syndiamesa dampfi Kieffer, 1924: 50.

Imago mâle

Cf. Serra-Tosio, 1970.



Fig. 3.1–6. *Diamesa dampfi* (Kieffer), femelle. 3.1 aile, 3.2–3 Ta_4 des pattes en vue latérale et dorsale, 3.4 hypopyge en vue ventrale, 3.5 lobe ventrolatéral et pan (= «flap») en vue ventrale, 3.6 hypopyge en vue latérale.

Imago femelle

Diagnose

Antenne avec dorsalement une sensille coeloconique à microtriches sur les flagellomères 1 à 3. Flagellomère 6 sans soies et flagellomère 7 sans soies préapicales. Yeux à pubescence courte. R_{4+5} de l'aile fortement courbée. Ta_4 de chaque patte un peu aplati et élargi à l'extrémité distale, mais pas nettement bilobé. Capsules spermathécales grosses. Bord postérieur du pan (= «flap») échancré au niveau du lobe ventrolatéral. Tergite IX avec deux plaques étroites transversales. Gonocoxite digitiforme. Cerques arrondis, un peu allongés du côté postérieur.

Description (n = 1)

Longueur totale: 5,01 mm. Longueur/largeur de l'aile: 4,04/1,43 mm. Longueur totale/longueur du fémur antérieur: 2,62.

Antenne: scape sans soies. Pédicelle avec 2 soies. Flagellomères 1 à 6 avec respectivement le nombre de soies suivant: 6, 5, 5, 4, 4, 0. Dernier flagellomère avec 2 soies apicales. Longueur maximale des soies antennaires: 169 μm. Longueur/largeur du pédicelle: 45/102 μm. Longueur/largeur des flagellomères 1 à 7: 83/45, 53/38, 60/34, 60/26, 41/15, 146/30 μm. AR 0,39. Une sensille coeloconique à microtriches dorsalement sur chaque flagellomère 1–3.

Tête: suture coronale complète. Sensilles frontales à 130 μm l'une de l'autre, et chacune environ à 25 μm de l'apex de la protubérance frontale. Protubérances frontales très saillantes. Soies temporales:

environ 40. Microtriches oculaires ne dépassant pas les facettes latérales. Clypéus avec 4 soies. Longueur/largeur du clypéus: 140/150 μm. Longueur/largeur des articles du palpe: 45/45, 87/49, 169/49, 154/41, 245/30 μm. «Palpal stoutness» (Hansen & Cook, 1976): 3,86. Tentorium avec un processus antérolatéral bien marqué.

Thorax: antépronotum dépassant un peu la protubérance scutale, avec 9 soies pronotales latérales. Soies acrosticales absentes. 13 à 15 soies dorsocentrales. 11 soies préalaires disposées sur 1 à 2 rangs. Protubérance de l'épiméron et préépisternum sans soies. 26 soies scutellaires.

Aile (Fig. 3.1): coloration brunâtre clair. VR 0,90. R_1 peu arquée, faiblement recourbée vers l'avant et prolongée du côté distal. RM très courbée. R_{4+5} relativement fortement arquée. Microtriches de la membrane alaire visibles dès le grossissement 50×. Brachiolum avec 1 soie distale et 1 soie basale. R avec 24 soies, R_1 avec 19 soies, R_{2+3} avec 0 à 1 soie, R_{4+5} avec 20 soies, et RM avec 0 à 1 soie. Alula avec 1 soie. Squame avec environ 30 soies. Sensilles campaniformes: 4 sur Sc, 2 sur R_1, 1 sur R_{2+3}, 3 à 4 sur R_{4+5}.

Pattes (Fig. 3.2–3): éperons des tibias: 86 μm (P_1); 83 et 79 μm (P_2); 128 et 75 μm (P_3). Peigne du tibia de P_3 avec 16 soies (41 à 79 μm). 2 soies spiniformes apicales sur seulement chacun des deux premiers articles de chaque tarse. Soies spiniformes préapicales des tarses: 0,0,0 (P_1); 13,6,0 (P_2); 22,7,4 (P_3). Sensilles chétiformes: environ 160 réparties depuis le 0,13 jusqu'au 0,92 du métatarse de P_3. 4e article du tarse un peu aplati dorsoventralement, en vue dorsale faiblement élargi à l'extrémité (Fig. 3.3). Pulvilles petites, visibles au grossissement 300×.

Longueurs (en μm) et proportions des articles des pattes:

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV	BR
P_1	1543	1852	1211	586	374	135	165	0.65	3.66	2.80	3.1
P_2	1663	1734	816	432	256	113	162	0.47	4.37	4.16	2.4
P_3	1852	2018	1235	672	374	128	180	0.61	3.77	3.13	2.4

Hypopyge (Fig. 3.4–6): sternite VIII avec de chaque côté 8 à 12 soies. Gonocoxapodème distinct, plus ou moins parallèle au bord postérieur du sternite. Gonapophyse VIII triangulaire en vue ventrale, à bords médian et postérieur formant un angle aigu; bord médian très allongé ventralement, formant une saillie parallèle à l'axe du corps; bord postérieur échancré au niveau du lobe ventrolatéral (Fig. 3.4–5); lobe ventrolatéral presque entièrement entouré par le pan (= «flap»), sauf dans sa partie médiodistale (Fig. 3.5). Capsules séminales grosses, ovoïdes; longues d'environ 240 μm, apparemment sans ponctuation superficielle. Conduits spermathécaux très longs. Gonocoxite à limite basale indistincte; partie distale droite, digitiforme et dirigée vers l'arrière, portant 9 soies sur son extrémité. Tergite IX avec deux plaques transversales, assez étroites et complètement separées l'une de l'autre; chaque plaque porte 17 à 18 soies longues. Protubérance du segment X faiblement developpée. Cerques allongés du côté postérieur.

Nymphe

Cf. Serra-Tosio, 1970; Ferrarese & Rossaro, 1981.

Larve

Cf. Rossaro, 1980; Ferrarese & Rossaro, 1981.

Remarque:

La femelle de *D. dampfi* a été insuffisamment décrite par Kieffer (1924) et en pratique elle est restée inconnue jusqu'à maintenant. Par rapport aux autres femelles de *Diamesa*, on remarque dans le groupe *dampfi* (Serra-Tosio, 1970) une synapomorphie nette dans la configuration des spermathèques, c'est-à-dire des capsules très larges et des conduits longs. On remarque aussi des différences distinctives entre les trois espèces du groupe *dampfi*. Cette espèce se distingue de *D. permacra* (Walker) et de *D. thomasi* Serra-Tosio en particulier par le gonocoxite digitiforme de son hypopyge.

Répartition

Alpes françaises, Forêt-Noire, Tyrol (Serra-Tosio, 1973).

Matériel examiné

France: Revel (38), bords du Doménon en amont de l'Oursière; 1610 m; leg. B. Serra-Tosio; 10.9.1982; 1 mâle, 1 femelle. Huez (38), affl. du lac Besson; 2110 m; leg. B. Serra-Tosio; 8.9.1983; 2 exuvies nymphales mâles, 3 nymphes femelles.

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Tanytarsus curvicristatus spec. nov. eine neue Chironomidenart aus Kolumbien

(Diptera, Chironomidae)

Von **Ruth Contreras-Lichtenberg**

Abstract

A new species of Tanytarsini is described on the morphological characters of the male imago from Colombia, South America. The specimens have been collected in the Central Andes, south of the Nevado del Ruiz in 2115 m above sea-level. Larvae, pupae and females of the new species are unknown, as well as its ecology.

Einleitung

Im Juni 1976 konnten in Kolumbien schwärmende Männchen einer *Tanytarsus*-Art gesammelt werden. Die Tiere stammen aus der Zentralkordillere, südlich des Nevado del Ruiz, aus dem Bereich des Rio Otún und wurden bei einer Forellenzuchtstation „El Cederal" 25 km östlich von Pereira in 2115 m Seehöhe gefangen. Der Fundort liegt in der subtropischen Klimaregion Kolumbiens.

Aus Südamerika sind nur wenige Tanytarsini-Arten beschrieben (Kieffer 1917, 1925, Rempel 1939, Roback 1960, Reiss 1972, 1985, Reiss & Sublette, 1985).

Tanytarsus curvicristatus spec. nov.

Etymologie: Latein, der Name bezieht sich auf die deutlich median- und dorsalwärts gekrümmten Analkämme.

Material: Holotypus, ♂, 9 Paratypen, ♂♂. (Holotypus und 7 Paratypen Naturhistorisches Museum Wien, 1 Paratypus Zoologische Staatssammlung München, 1 Paratypus Instituto de Ciencias Naturales, Universidad Nacional Bogotá, Kolumbien), alles Mikropräparate, Euparal; El Cederal, Forellenzuchtstation im Bereich des Rio Otún, 2115 m SH, Lichtenberg leg. 17. 6. 1976.

Imago ♂

Färbung: dunkelbraun, Thorax im mazerierten und präparierten Zustand: längs der Mitte heller als lateral, Scutellum und Postnotum dunkel, Postnotum mit heller Mittellinie, Halteren braun, Beine braun, Tibien der PII und PIII mit dunklen Kämmen und Spornen.

Größe: größere Art, Flügellänge 2,02 (1,8–2,3) mm; n = 5

Kopf: keine Stirnzapfen vorhanden, 8 (8–10) Vertexborsten (n = 5), 13 (10–15) Clypeusborsten (n = 4), Augen unbehaart. Länge der Palpomeren in μm: Pm 1:36 (32–44); Pm 2: 54 (48–60); Pm 3:119 (116–120); Pm 4: 89 (80–100); Pm 5: 154 (140–160); n = 3.

Antenne: mit 13 Flagellomeren, AR = 0,69 (0,51–0,86); n = 5.

Flügel: (Abb. 1 E) Costa nicht über R_{4+5} hinaus verlängert, Subcosta in Falte proximal von RM endend. R_{2+3} und R_{4+5} eng nebeneinander parallel verlaufend, nur kurz vor der Mündung von R_{2+3} in

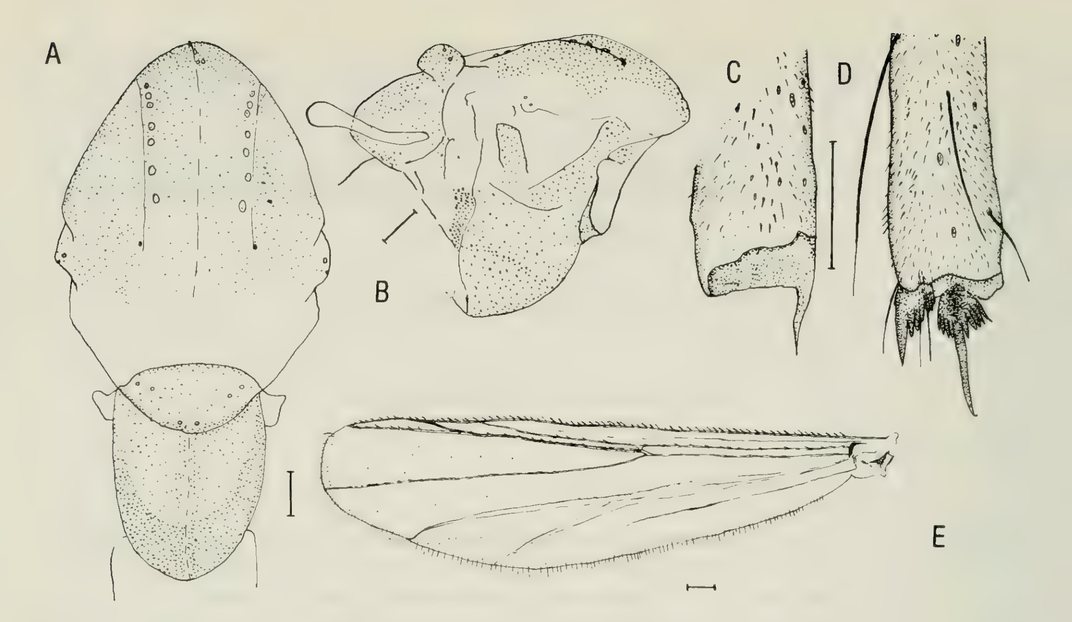


Abb. 1: *Tanytarsus curvicristatus* spec. nov. A, B, Thorax dorsal und lateral; C, P_1-Tibia. D, P_2-Tibia; E. Flügel. Maßstab: A, B, E – 100 μm. C, D – 50 μm.

die Costa divergierend. M_{3+4} knapp vor der Mündung in den Hinterrand des Flügels deutlich geschwungen. An auf der Höhe von FCu endend.

VR = 1,20 (1,16–1,23); n = 5.

Macrotrichien auf R_1, R_{2+3} und R_{4+5} sowie auf M_{1+2}, weiters auch an der Flügelspitze zwischen den Längsadern und parallel dem Flügelhinterrand, proximales Drittel des Flügelhinterrandes ohne Macrotrichien. Squama ohne Haarsaum.

Thorax: (Abb. 1 A, B) Pronotum stark reduziert, von dorsal nicht sichtbar. Humeralborsten fehlend, 8–9 Dorsocentralborsten, 4 Acrostichalborsten, jederseits 2 Präalarborsten, 6 Scutellumborsten.

Beine: (Abb. 1 C und D) Tibien der P_1 mit einem Sporn, Vordertarsen ungebartet, Tibien der P_2 und P_3 mit zwei voneinander getrennten schmalen Kämmen, jeder der beiden Kämme mit einem Sporn.

Länge der Beinglieder in μm

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	880(n=5)	419(n=5)	1004(n=2)	569(n=2)	450(n=2)	332(n=2)	163(n=2)	2,4 (n=2)
	(821-949)	(386-455)	(940-1068)	(534-603)	(425-475)	(307-356)	(158-168)	
P_2	880(n=7)	674(n=7)	407(n=6)	206(n=6)	155(n=6)	104(n=6)	79(n=6)	
	(831-940)	(613-712)	(366- 455)	(188-227)	(148-168)	(99-109)	(69-89)	
P_3	980(n=7)	838(n=7)	527(n=3)	353(n=3)	304(n=3)	191(n=3)	99(n=3)	
	(910-1058)	(762-910)	(504-544)	(346-356)	(297-307)	(178-198)	(89-109)	

Hypopyg: (Abb. 2) Analtergitbänder lang, konvergierend, gegen die Analspitze zu parallel verlaufend, am Ende der Analtergitbänder je zwei Setae. Analspitze deutlich ventralwärts gekrümmt, mit einem oralwärts gerichteten stangenförmigen Fortsatz, jederseits der Analspitze fünf Setae. Ein Paar

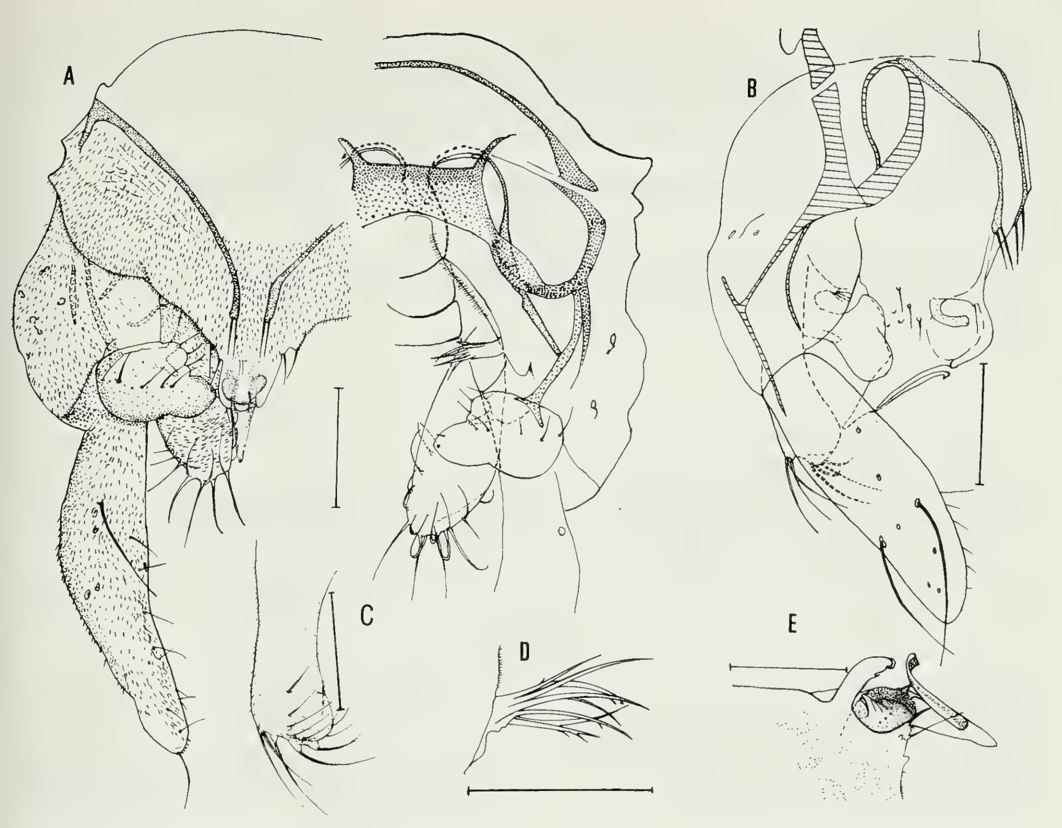


Abb. 2: *Tanytarsus curvicristatus* spec. nov. A, Hypopyg, dorsal; B, Hypopyg, lateral; C, Anhang 2, lateral; D, Anhang 2a; E, Analspitze. Maßstab: A, C, D. E – 50 μm; B – 100 μm.

deutliche median- und in Lateralansicht dorsalwärts gekrümmte Analkämme vorhanden. Jederseits der Analspitze ein Zahn. Anhänge 1 medianwärts mit einem Lobus und fünf in einer Reihe stehenden Setae, an der Basis zwei weitere, starr medianwärts gerichtete Setae. Digitus schmal, nicht über den Anhang 1 hinausragend, auf einem breiten basalen, eine Borste tragenden Höcker sitzend. Anhänge 2 keulenförmig, distal schwach zweilappig, mit über die gesamten Anhänge verbreiteten Microtrichien und distalen, dorsalwärts gekrümmten Setae. Anhänge 2a kurz, gerade, distal mit schlanken, spitzen, gespaltenen Lamellenborsten.

Imago ♀, Larve und Puppe: unbekannt.

Differentialdiagnose

Fehlende Stirnzapfen, knapp vor der Mündung in den Hinterrand des Flügels deutlich geschwungene M_{3+4}. Hypopyg: je 2 Setae am Ende der Analtergitbänder. Die Art unterscheidet sich von allen anderen *Tanytarsus*-Arten durch die median- und dorsalwärts gekrümmten Analkämme, die sich beiderseits der stark ventralwärts gebogenen Analspitze befinden sowie die Kombination dieser mit folgenden Merkmalen: querorientierte in einen medianwärts gerichteten Lobus endende Anhänge 1, Analspitze mit oralwärts gerichtetem stangenförmigem Fortsatz schmaler, nicht über den Anhang 1 hinausreichender Digitus, distal keulenförmig erweiterte Anhänge 2 mit schwach angedeuteter Zweiteilung, kurze Anhänge 2a mit distalen, schlanken, spitzen, gespaltenen Lamellenborsten.

Die auffällig gekrümmten Analkämme könnten eine Zugehörigkeit zum Genus *Paratanytarsus* vermuten lassen (Reiss & Säwedal, 1981). Die Art wird aber dennoch zu *Tanytarsus* gestellt, da sie sich

von den Arten des Genus *Paratanytarsus* Thienemann & Bause, 1913 durch die lange Analspitze und den kurzen, schmalen Digitus unterscheidet. Weitere Arten mit einer oralwärts gerichteten Stange auf der Analspitze sind die vermutlich holarktische Art *Tanytarsus signatus* v. d. W. (Reiss & Fittkau, 1971) sowie die aus Australien beschriebene Art *Tanytarsus liepae* Glover 1973.

Danksagung

Herrn Dr. F. Reiss (Zoologische Staatssammlung München) danke ich für die Hilfe und wertvolle Hinweise bei der Diskussion der neuen Art.

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A reconsideration of the genus Apedilum Townes, 1945

(Diptera: Chironomidae)

By **J. H. Epler**

Abstract

The taxonomy of the genus *Apedilum* Townes, 1945 is reviewed. The adult males and females, pupae and larvae of the two Nearctic species, *A. elachistus* Townes and *A. subcinctum* Townes, are redescribed. A key for both species in all life stages is provided, and notes on the biology of the genus are given.

Introduction

The genus *Apedilum* was established by Townes (1945) for 2 species, *A. elachistus* Townes and *A. subcinctum* Townes (the type species). *Chironomus nigrohalteris* Malloch, 1915 was also included; this species was considered by Townes (1945: 33) to be a senior synonym of *Ch. (Lauterborniella) brachylabis* Edwards, 1929. Roback (1957: 97) noted that Lenz (1941: 48) had established the genus *Paralauterborniella* for *Ch. (L.) brachylabis.* Since then, all 3 species have been treated as members of *Paralauterborniella.* However, as demonstrated in this paper, *A. elachistus* and *A. subcinctum* are not congeneric with *P. nigrohalteris.* The genus *Apedilum* is resurrected for the species *elachistus* and *subcinctum,* and *Paralauterborniella* becomes a monotypic genus.

The larva and pupa of *A. elachistus* (as *Paralauterborniella)* were briefly described by Beck & Beck (1970); the larva and pupa of *A. subcinctum* (as *Paralauterborniella)* were figured and keyed by Darby (1962). Portions of the pupal morphology of *A. subcinctum* (as *Paralauterborniella)* were illustrated and discussed in Pinder & Reiss (1986). In this paper the adult males and females, pupae and larvae of both species are described/redescribed.

Methodology

Terminology follows Epler (1987) and Saether (1980); methodology follows Epler (1987). The female notum was measured from the anterior apex to its posteriormost point. Means are not given for samples of less than 3; all measurements are in micrometers unless otherwise stated. Abbreviations for collections from which material was borrowed are: BC = B. A. Caldwell, Georgia Dept. Natural Resources, Atlanta, GA, USA; CN = Canadian National Collection, Ottawa, Ontario, Canada (D. R. Oliver); FS = Florida State Collection of Arthropods at Florida A & M University, Tallahassee, FL, USA; GG = G. Grodhaus, California Dept. of Health, Vector Biology and Control Section, Berkeley, CA, USA; JE = J. H. Epler; KS = State Biological Survey of Kansas, Lawrence, KS, USA (L. C. Ferrington, Jr.); ZS = Zoologische Staatssammlung, Munich, West Germany (F. Reiss).

Biology

Apedilum larvae most often inhabit submerged vegetation. DARBY (1962: 145–146) and MAGY et al. (1970) give more detailed information on biology and emergence phenology for *A. subcinctum*. Mr. Broughton A. Caldwell (pers. comm., 1987) has been kind enough to provide the following information for *A. elachistus* collected in Georgia:

On collecting dates in June and August, water temperatures ranged from 25.0° to 39.0° C. The following water quality parameters were recorded from the collection site in June: flow = 0.10 cfs; D. O. = 7.2 mg/l; pH = 6.8; conductivity = 101μmho/cm; BOD_5 = 3.0 mg/l; fecal coliform = 4900 MPN/100 ml; total solids = 88 mg/l; suspended solids = 10 mg/l; total ammonia = 0.06 mg/l (as N); $NO_2 + NO_3$ = <0.02 mg/l (as N), and total P = 0.53 mg/l.

Collection data for *A. elachistus* in Florida indicate that adult emergence takes place year round. In addition to occurring in freshwater, I have collected *A. elachistus* larvae from submerged vegetation in a brackish pond in Florida.

Systematics

Apedilum is distinguished from *Paralauterborniella* by the following characters (*Paralauterborniella* in parentheses):

adult male: superior volsella globose (digitiform), gonostyli well developed (strongly reduced);

adult female: labia without microtrichia (with microtrichia), seminal capsule with distinct neck (without distinct neck);

pupa: cephalic tubercles absent (present), no nose present on wing sheath (present), 5 lateral lamellar setae on T VIII (4);

larva: mentum with deeply bifid median tooth (dome-shaped single median tooth), S II with short basal segment (long basal segment), pecten epipharyngis a single plate (2 plates), ventromental plates finely striated (coarsely striated), maxillary plate with well defined striae (weakly defined striae), mandible with 2 dorsal teeth and well developed pecten mandibularis (no dorsal teeth and reduced pecten mandibularis) and supraanal setae approximately equal to length of anal tubules (much longer than anal tubules).

Apedilum is probably most closely related to *Zavreliella* Kieffer and *Paralauterborniella*, and possibly *Oukuriella* Epler, as suggested by EPLER (1986). The sclerotized neck of the seminal capsule is a synapomorphy shared with *Zavreliella* (as *Lauterborniella* in SAETHER 1977).

At least one other species of *Apedilum* occurs in the Neotropics. I have examined associated larvae and pupae from the Rio Marauiá, Amazonas, Brazil which represent a new species. Only pharate adults within their pupal exuviae were available. The genitalia were similar to those of *A. elachistus* and *A. subcinctum*, but the larvae and pupae were distinctive. The undescribed larva has 52–55 maxillary plate striae and 2 sclerotized areas on the anteromedial portion of the frontoclypeal apotome. (*A. elachistus* and *A. subcinctum* larvae have the anterolateral portions of the frontoclypeal apotome sclerotized.) The pupa has 5 lateral lamellar setae of equal width, only 11–20 T II hooklets, the T VIII caudolateral comb is a cluster of small spines, and the thoracic horn has only 3 branches. Because completely developed, associated adults are not available, a complete description is not offered at this time.

Genus Apedilum Townes

Apedilum TOWNES, 1945: 32. Type-species: *Apedilum subcinctum* Townes, 1945, by original designation (misspelled as *succinctum*).

Paralauterborniella Lenz, 1941 (partim): ROBACK 1957: 97 (synonymized *Apedilum* with *Paralauterborniella*); PINDER & REISS 1983: 330 (larva); PINDER & REISS 1986: 341 (pupa).

Adult male.

Small chironomids, light brown to greenish-brown in general coloration. Wings with or without spots, wing length 1.1–1.8 mm.

Eyes bare. Temporal setae in single row beginning mesad to dorsomesal extension of compound eye, ending behind approximate middle of eye. Frontal tubercles minute (<2 micrometers). Antennal flagellum with 13 flagellomeres. Maxillary palp 5-segmented, basal segment weakly sclerotized. Clypeus subquadrate, setose. Cibarial setae present.

Antepronotum bare, narrowed and weakly notched dorsomesally. Thoracic scar small; humeral "pit" present as a single tubercle or 1 large tubercle with smaller tubercles, dorsocaudally to thoracic scar. Scutal tubercle absent. Acrostichal setae present in double row, anteriorly beginning close to antepronotum and running posteriorly to approximate mid-scutum. Dorsocentral setae in single row/side, with scattered sensilla campaniformia along setal row. Scutellar setae usually in 1 row. Supraalar seta 1/side. Prealar setae about 1–4/side.

Wing membrane without macrotrichia; squama without setal fringe. Brachiolum with 1 seta and 2 groups of campaniform sensilla; R, R_1 and R_{4+5} usually with setae, R_{4+5} occasionally bare; costa ends at R_{4+5}; FCu distal to RM; RM oblique to R_{4+5}.

Metatarsal beard absent on foreleg. Foretibia without apical scale or spine. Middle and hind tibiae each with 2 combs, apparently fused; outer comb bearing one larger spine which projects beyond others. Sensilla chaetica present on metatarsus of middle leg, confined to apical $^1/_5$; also sometimes present on apical $^1/_5$ of hind metatarsus. Pulvilli vestigial; empodium thin, with sparse ventral fringe.

Gonostylus moderately inflated, short, slightly longer than gonocoxite, with straight inner margin; bearing several long setae along inner margin. Superior volsella well developed; globose-pediform, with microtrichia dorsally and ventrally; often membranous apically; bearing several to many large sensilla chaetica on mesal and dorsal surface. Inferior volsella well developed, elongate-digitiform, slightly arched dorsoventrally, with preapical and apical sensilla chaetica. T IX with small group of setae on each side posteriorly; anal point present or absent.

Female.

Generally similar to male; abdomen and wings stouter, and overall generally more setose than male. Antennae with 5 apparent flagellomeres. Frontal tubercles vestigial or absent.

Mid and hind metatarsi with 1–2 rows of sensilla chaetica on distal $^1/_2$–$^2/_3$.

Genitalia with well developed dorsomesal and ventrolateral lobes; a narrow, bare apodeme lobe present. Posteromesal angle of S VIII with a shelf which extends partially over ventrolateral lobe. Labia without microtrichia. Seminal capsules spherical with distinct, more heavily sclerotized neck; spermathecal ducts without major loops or bends.

Pupa.

Small pupae, 3–5 mm long. Exuviae colorless to pale brown with light yellow-brown margins, cephalothorax darker. Cephalic tubercles absent, frontal setae well developed, lamellar. Dorsum of thorax moderately granulose, without scutal tubercle. Thoracic horn with 4 (6?) partly spinose or serrate branches; base of thoracic horn circular, with 1 apparent tracheal bundle. Thoracic setae/side: precorneal 2; dorsocentral 4 in 2 groups; median antepronotal 1; lateral antepronotal 1. Wing sheath without "nose" or at most a slight protuberance.

Abdominal segment I without lateral setae; segment II with 4 lateral hairlike setae, III with 4 lateral hairlike setae or 3 hairlike setae and 1 lamellar seta or 2 hairlike setae and 2 thin lamellar setae; IV with 2 hairlike and 2 lamellar lateral setae or 3 hairlike and 1 lamellar lateral setae; V-VII with 4 lateral lamellar setae; VIII with 5, rarely 4, lateral lamellar setae. Anal lobe with a pair of thin dorsal caudolateral setae and a fringe of 15–30 ventral lateral lamellar setae on each lobe. An uninterrupted median row of caudal hooklets on T II.

Intersegmental conjunctiva of T III/IV/V with fine to coarse spinules (usually poorly developed or absent on T III).

Caudolateral corners of VIII with one large spine or a comb of several smaller spines. Shagreen absent on T I. Dorsal shagreen on T II–VI subquadrate in outline, slightly wider anteriorly; shagreen points larger anteriorly. Segments VII and VIII with rounded anterolateral shagreen areas. Anal lobes without shagreen. Ventral shagreen present only on S VII and VIII as paired, weakly developed, round anterolateral areas. Pedes spurii A present on S IV, pedes spurii B present on segments I and II. Segments II–VIII with one dorsal and one ventral pair O-setae.

Larva.

Small larvae, 3–5 mm long. Body greenish-gold (Darby 1962: 145) in life. Head capsule pale yellow, with 2 pairs of eyespots.

Antenna with 6 segments, segment 4 approximately equal to 2. Antennal blade approximately as long as flagellum, with small accessory blade. Lauterborn organs well developed, alternately placed at apices of 2 and 3; a well developed style present near apex of segment 3. Ring organ present at approximate middle of basal segment.

Frontoclypeal apotome narrowed anteriorly, with anterolateral corners produced and more heavily sclerotized. Labrum with setae I–IVA+B present; S I broad, plumose, with toroidal bases joined medially; S II large, fringed, with short basal segment; S III hairlike, with small basal pedestal; S IVA small, two-segmented; S IVB smaller than S IVA, inflated, simple. Labral lamella with fringe. Pecten epipharyngis a distally broader, quadrilateral plate with 8–15 distal teeth. Premandible distally bifid, the inner blade wider than outer blade, with 1 smaller inner medial tooth; a medial premandibular brush present.

Mandible with apical tooth, 2 dorsal preapical teeth, and 3 inner teeth. Pecten mandibularis composed of 8–11 strong setae. Seta subdentalis simple, well developed, 8–15 times longer than wide. Seta interna with 4 main branches, united basally.

Mentum with deeply bifid pale median tooth and 6 pairs of darker lateral teeth; 1st lateral teeth small and appressed to 2nd lateral teeth. Ventromental plates about twice as wide as long, with smooth anterior margin and continuous fine striae. Setae submenti simple. Maxillary plate with well developed striations. Triangulum occipitale not visible in ventral view.

Lateral and ventral tubules absent; 2 pairs of conical anal tubules. Procercus about as wide as long, with 6–8 large apical setae and 2 small, fine anterolateral preapical setae. Supraanal setae subequal to anal tubules.

Key to all stages of Nearctic Apedilum

1. Adults 2
– Immature stages 3

2. Wing with pale spots; male never with anal point . . . . *A. elachistus*
– Wing immaculate; male with or without anal point . . . . *A. subcinctum*

3. Pupae 4
– Larvae 5

4. Caudolateral angle of T VIII with 1 large spur or large spur with smaller basal spur (s); T VIII lateral setae of equal width (Figs. 3 d, e) . . . . *A. elachistus*
– Caudolateral angle of T VIII with group of smaller spurs; T VIII with 1 lateral seta thinner than other 4 (Figs 3 f, g, h) . . . . *A. subcinctum*

5. 90–105 maxillary plate striae . . . . *A. elachistus*
– 110–125 maxillary plate striae . . . . *A. subcinctum*

Apedilum elachistus TOWNES, 1945: 33 (adult description).
Paralauterborniella elachista (Townes): SUBLETTE & SUBLETTE 1965: 173 (placement); BECK & BECK 1970: 30 (pupa, larva description).
nec *Paralauterborniella elachista* (Townes): DARBY 1962: 47, 64, 88, 143 (misdetermination of *A. subcinctum*).

Male Imago (n = 5)

Color. Head and thorax light brown to dark brown; abdomen light brown to brown suffused with green, or completely light green with light brown areas on dorsum. Legs cream to pale brown, apices of femora sometimes darker brown. Wings with pale gray spots surrounding base of R_{4+5}; in center and apex of r_{4+5} (these 2 spots sometimes joined by a narrow bridge); along R_{4+5} from approximate midpoint to apex; at FCu and extending along Cu_1; and below An (see TOWNES 1945: fig. 205).

Length. Total 2.12–2.97, 2.69 mm. Thorax 0.69–0.84, 0.80 mm. Abdomen 1.43–2.13, 1.89 mm.

Head. Setae: temporal 20–32, 26; clypeal 12–16, 14; cibarial 4. Palpomere lengths (4): 28–40, 32; 30–45, 35; 63–90, 72; 90–105, 100; 123–173, 146. AR 0.83–1.23, 1.06.

Thorax. Setae: acrostichals 10–12, 11; dorsocentrals 16–24, 20; scutellars 6–9, 7; prealars 1–4, 4.

Wing. Length 1.13–1.48, 1.38 mm; with 0.35–0.49, 0.43 mm. VR 0.74–0.78, 0.76. Setae: $R+R_1$ 8–25, 15; R_{4+5} 0–19, 8.

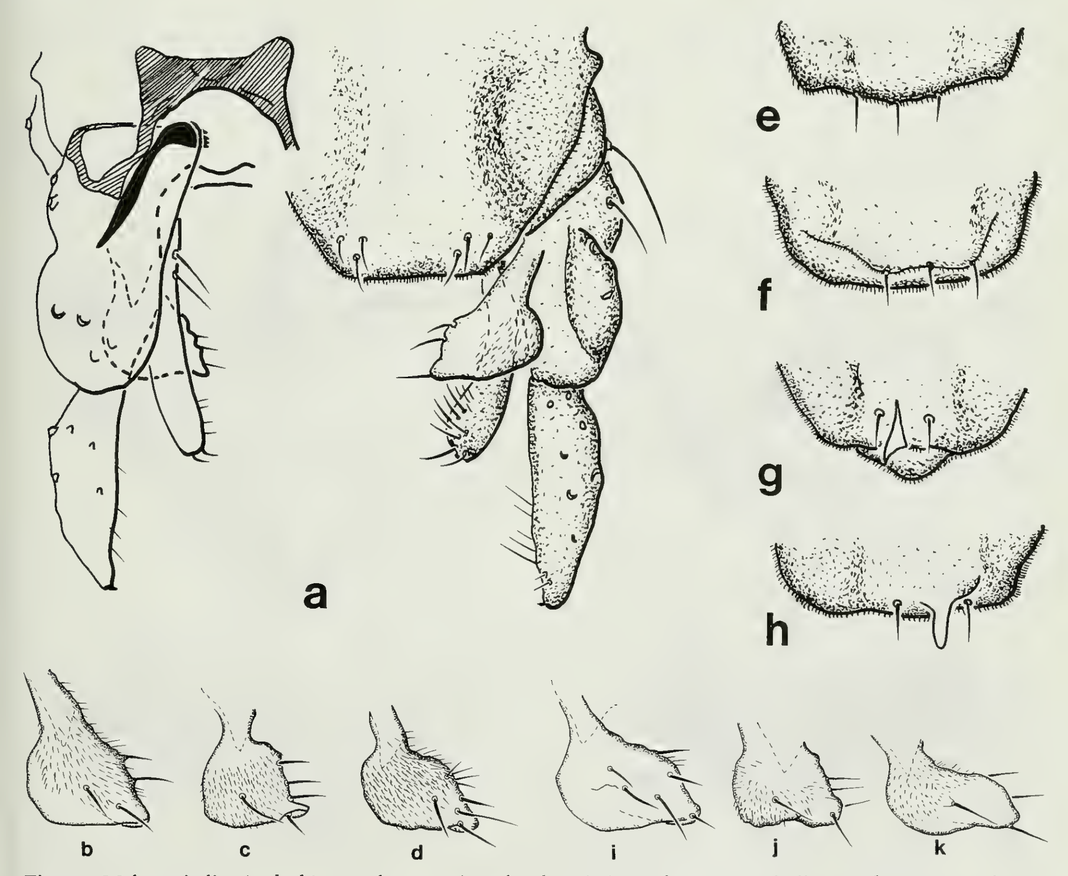


Fig. 1. Male genitalia. *A. elachistus:* a. hypopygium; b–d. variations of superior volsella. *A. subcinctum:* e–h. variations of caudal apex T IX, anal point; i–k. variations of superior volsella.

Legs. Palmate sensilla chaetica: 4–11, 7 on middle metatarsus, 0–1 on hind metatarsus. Lengths and proportions of legs:

♂	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV
P_1	500-650, 586	415-550, 513	590-660, 618 (3)	280-330, 297 (3)	220-255, 232 (3)	135-180, 152 (3)	90-100, 93 (3)	1.07-1.27, 1.16 (3)	2.12-2.40, 2.29 (3)	1.77-1.95, 1.85 (3)
P_2	560-725, 637	440-570, 511	290-335, 308	130-169, 147	90-115, 107	50-70, 65	40-70 60	0.57-0.66, 0.60	3.67-4.16, 3.85	3.45-3.89, 3.72
P_3	580-750, 672	500-640, 602	380-475, 444 (4)	190-260, 235 (4)	170-220, 204 (4)	90-110, 103 (4)	60-80, 73	0.73-0.76, 0.74 (4)	2.63-3.01, 2.79 (4)	2.80-2.93, 2.85 (4)

Hypopygium (Figs 1 a–d). As in generic description. Anal point absent.

Female Imago (n = 4)

Color. Similar to male.

Length. Total 1.85–2.17, 2.04 mm (3). Thorax 0.65–0.76, 0.71 mm (3). Abdomen 1.20–1.46, 1.33 mm (3).

Head. Setae: temporal 23–24, 24; clypeal 19–25, 23; cibarial 3–5, 4. Palpomere lengths: 22–28, 24; 23–33, 27; 53–58, 55; 70–90, 81; 113–128, 120 (3). AR 0.41–0.49, 0.45.

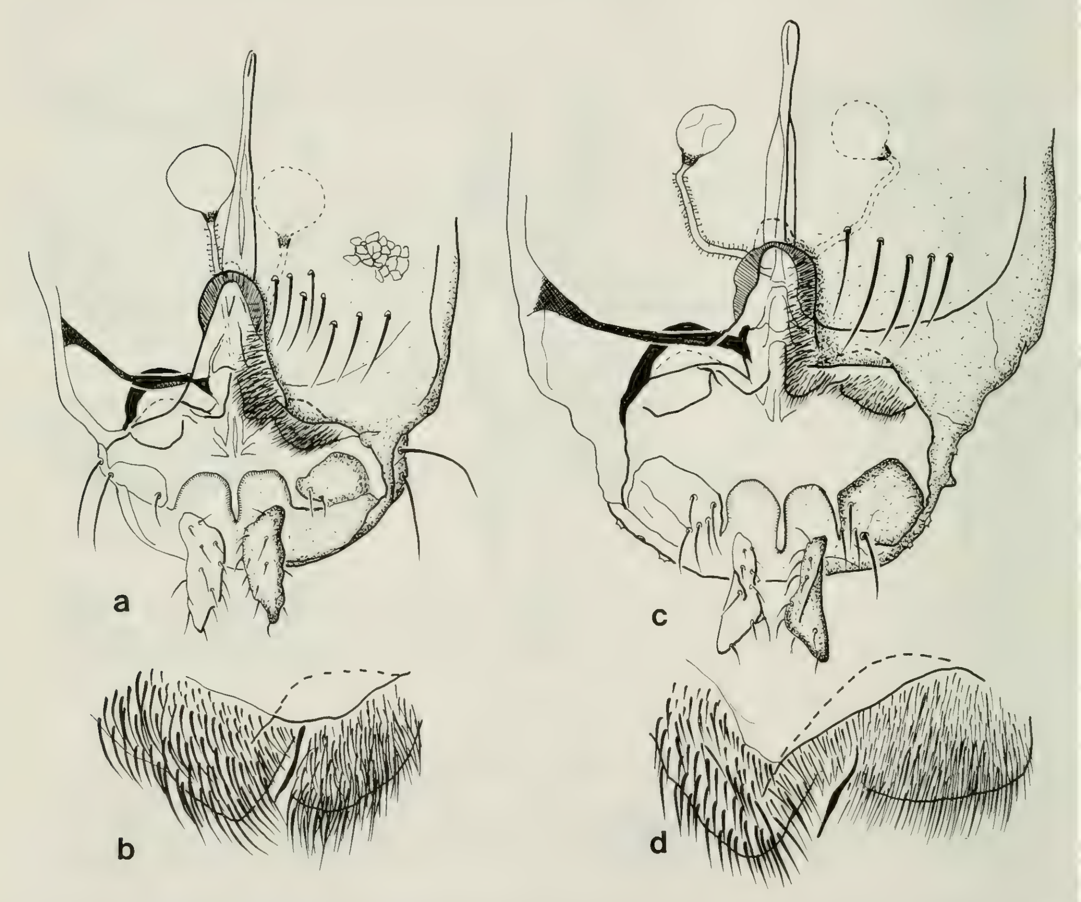


Fig. 2. Female genitalia. *A. elachistus:* a. apex of abdomen, ventral aspect; b. DmL, Apl, VlL. *A. subcinctum:* c. apex of abdomen, ventral aspect; d. DmL, ApL, VlL.

Thorax. Setae: acrostichals 6–11, 9; dorsocentrals 26–32, 29; scutellars 7–8, 8; prealars 4.

Wing. Length 1.26–1.43, 1.36 mm; width 0.48–0.54, 0.51 mm. VR 0.70–0.74, 0.72. Setae: $R+R_1$ 18–22, 20; R_{4+5} 10–19, 15.

Legs. Palmate sensilla chaetica: 18–25, 21 on middle metatarsus; 17–22, 20 on hind metatarsus. Lengths and proportions of legs:

♀	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV
P_1	460-520, 494	415-470, 444	470-520, 504	195-220, 211	140-160, 150	90-110, 103	65-75, 73	1.09-1.17, 1.14	2.65-2.74, 2.69	1.80-1.94, 1.86
P_2	520-585, 561	420-480, 463	240-270, 261	105-130, 118	70-85, 79	40-55, 48	45-55, 53	0.56-0.57, 0.57	4.17-4.54, 4.35	3.89-3.94, 3.92
P_3	560-630, 603	510-580, 553	350-400, 378	185-220, 204	160-190, 174	70-90 81	60-70, 68	0.68-0.69 0.68	2.85-2.99, 2.92	3.03-3.11, 3.06

Abdomen. Notum 162–175, 168; cerci 73–87, 81 long. S VIII with 5–9, 7 setae/side; T X with 12–21, 15 setae; Gc IX with 1–2 setae/side. DmL, VlL and ApL as in Figs. 2a, b.

Pupa: (n = 7)

Color. Clear with pale yellow-brown borders.

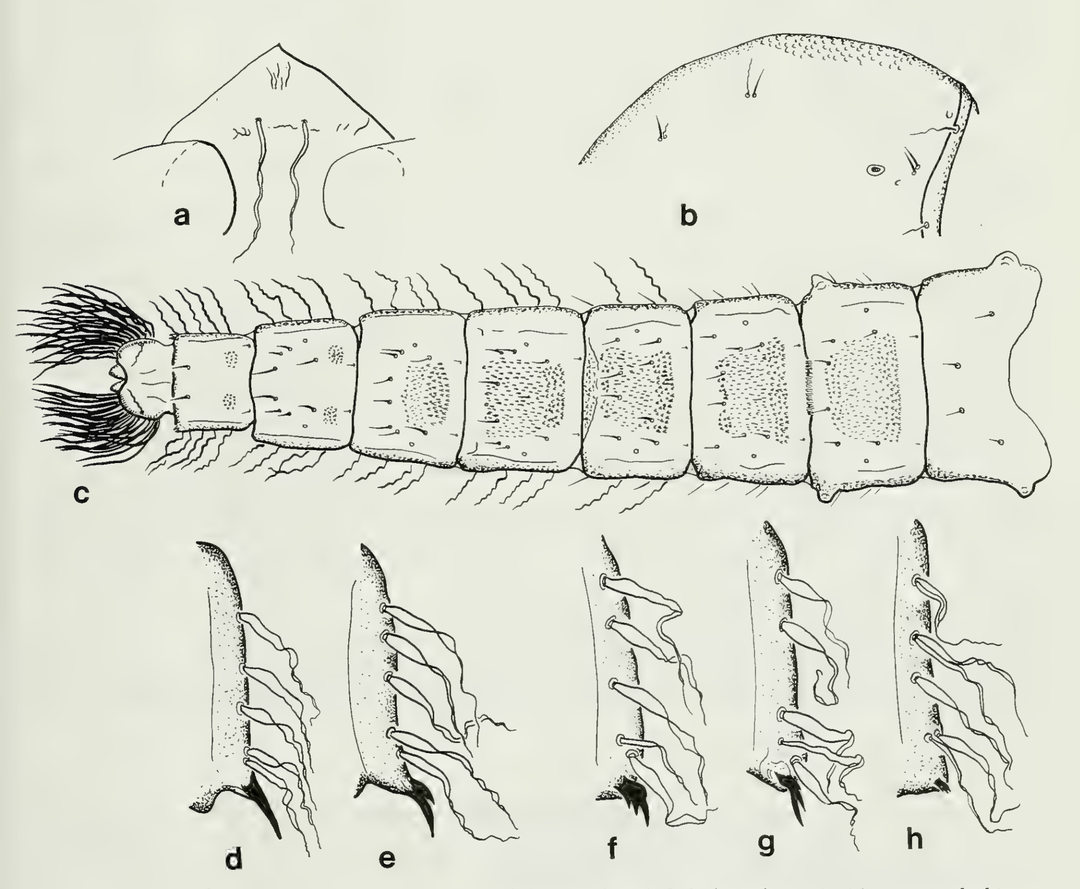


Fig. 3. Pupa. *A. subcinctum:* a. frontal apotome; c. abdomen, dorsal; f–h. lateral margin, T VIII. *A. elachistus:* b. thorax, lateral aspect; d–e. lateral margin, T VIII.

Length. Total 1.98–2.34 mm (3). Cephalothorax 0.66 mm (1). Abdomen 1.68 mm (l).

Abdomen (similar to *A. subcinctum*, Fig. 3c). Shagreen as in generic description. Posterior margin of T II with transverse row of 26–30, 28 (4) hooklets. T VIII with 5 equally sized lamellar lateral setae. Caudolateral spurs on T VIII (Figs. 3d, e) single or with small basal spurs. Anal lobes with 16–28, 20 setae. DR 1.65–3.20, 2.23.

Fourth instar larva: (n = 9)

Color. Head capsule light yellow.

Head. Postmentum length 113–125, 118 (8). Mandible (Fig. 4c) length 103–113. Pecten mandibularis composed of 8–11, 10 setae. Mentum width 80–90, 84 (5). Ventromental plate with smooth anterior margin; width 69–80, 74; length 32–37, 35; VPR 1.86–2.41, 2.13; IPD 15–18, 17 (3); PSR 4.11–5.33, 4.61 (3); 90–105, 100 (8) maxillary plate striae. Length of antennal segments (7): 60–66, 62; 13–16, 15 (6); 16–20, 17; 12–14, 13; 6–9, 7; 4–6, 5. AR 0.95–1.15, 1.05 (6). Frontoclypeal apotome as in Fig. 4b.

Remarks.

There are 2 apparent forms of adult male *A. elachistus*. Those with a low AR (0.83–0.85) have high $R+R_1$ (23–25) and R_{4+5} (17–19) setal counts and a low number (4–5) of palmate sensilla chaetica on the mid metatarsus. Those with a higher AR (1.19–1.21) have 8–12 $R+R_1$ and 0–2 R_{4+5} setae and a higher number (7–11) of palmate sensilla chaetica on the mid metatarsus. These differences were noted in California and Florida populations.

I have also examined 2 males from Piedra de los Indios, Colonia, Uruguay which probably are this species. The genitalia are indistinguishable from *A. elachistus* and the wing markings, although much fainter, are similar.

Townes (1945) also recorded *A. elachistus* from Alabama, Mississippi and its type locality in Galveston, Texas.

Material examined (BLT = black, light trap): U.S.A.: CALIFORNIA: Imperial Co., Wister Wildlife Management Area nr Niland, swarming along canal, 26-XII-1981, leg. J. H. Epler, 30 males (JE). FLORIDA: Broward Co., Plantation Canal, 9-II-1960, W. Beck, 1 larva (FS); Dade Co., Gould's Monkey Jungle, BLT, 24-IV-1968, R. E. Woodruff, 1 male (FS); Homestead, BLT, R. Baranowski, 1 male (FS); Duval Co., Jacksonville, BLT, 30-IX-1969, R. King, 12 males (FS); Hamilton Co., roadside ditch nr Occident, 6-IX-1967, W. Beck, 1 male/Pex/Lex (FS); Leon Co., Tallahassee, 2112 Faulk Dr., at light, 5-VI-1980, Leg. A. R. Soponis, 1 male (FS); Marion Co., Sharpe's Ferry Field Sta., malaise trap, 8–13-X-1975, W. R. H., 1 male (FS); Monroe Co., Big Pine Key, light trap, 10-IV-1970, W. W. Wirth, 7 males, 1 female (FS); Big Pine Key, BLT, 25-V-1978, L. Stange, 1 male (FS); Stock Island, BLT, 25-I-1967, F. A. Buchanan, 1 male (FS); Palm Beach Co., Palm Beach (residence), 4-XII-1979, R. P. Tomasello, 9 males, 3 females (FS); St. John's Co., St. John's River, W. Beck, 1 male/Pex/Lex (FS); Taylor Co., Hickory Mounds Impoundment, 20-II-1983, leg. J. H. Epler, 51 males (JE); Wakulla Co., St. Marks Natl. Wldlf. Ref., lighthouse pool, 19-IV-1980, swarms totaling approx. 600 males & females (JE); same locality & collector, 30-IV-1980, 37 males, 1 female (JE); same locality & collector, BLT, 30-V-1980, 66 males, 3 females (JE); same locality & collector, 6-II-1983, 80 males (JE); same locality & collector, 8-III-1986, 1 larva (JE); St. Marks Natl. Wldlf. Ref., Stony Bayou Pool, 23-IX, 27-X-1984, leg. J. H. Epler, 75 males (JE); St. Marks Natl. Wldlf. Ref., Nature Trail, 25-XII-1984, leg. J. H. Epler, 14 males (JE). Also probably from FL: 5 males/Pex/Lex – no data – (FS). GEORGIA: Pierce Co., Sixty Foot Branch 1.0 mi downstream of confluence "Patterson Creek", 18-VI-1986, leg. B. A. Caldwell & V. Barnes, 2 pupae, 5 larvae (BC); same locality, 20-VIII-1986, leg. B. A. Caldwell & C. Stevens, 1 pharate female pupa/Lex (BC).

Apedilum subcinctum Townes

Apedilum subcinctum Townes, 1945: 33 (adult description).

Paralauterborniella subcincta (Townes): Sublette 1960: 202 (adult description, placement); Darby 1962: 47, 64, 88, 143 (figures of larva, pupa, adult; biology); Sublette & Sublette 1965: 173 (placement); Magy, et al. 1970:

115 (biology; although often cited as pp. 116–119, a note from Grodhaus on the reprint indicates original pagination was 115–119).
Paralauterborniella subcincta alamedensis Sublette, 1960: 203 (description of variant subspecies).

Male Imago (n = 5)

Color. Head and thorax brown to almost black; abdomen light brown to dark brown, sometimes suffused with green, or completely green with light brown areas on dorsum. Legs pale brown, base of femora sometimes lighter; femora darker than remainder of leg. Wings immaculate.

Length. Total 2.43–3.20, 2.74 mm (4). Thorax 0.68–0.90, 0.70 mm (4). Abdomen 1.75–2.30, 1.95 mm.

Head. Setae: temporal 18–38, 28 (4); clypeal 13–22, 18 (4); cibarial 4–5, 4 (3). Palpomere lengths (4): 40–49, 44; 33–58, 43; 85–161, 116; 88–150, 116; 140–180, 164 (3). AR 0.66–1.59, 1.15 (4).

Thorax. Setae: acrostichals 9–12, 11; dorsocentrals 15–30, 21; scutellars 6–10, 8; prealars 3–4, 4.

Wing. Length 1.25–1.73, 1.48 mm; width 0.37–0.46, 0.41 mm. VR 0.78–0.81, 0.79 (3). Setae: $R+R_1$ 13–16, 15 (3); R_{4+5} 1–22, 9.

Legs. Palmate sensilla chaetica: 4–7, 6 on middle metatarsus, 0–2 on hind metatarsus. Lengths and proportions of legs (4):

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV
P_1	600-740, 655	460-680, 583	570-650, 608	280-360, 320	215-270, 243	140-185, 165	85-105, 96	0.96-1.28, 1.06	2.16-2.29, 2.24	1.80-2.18, 2.03
P_2	650-800, 718	515-665, 595	310-360, 329	140-205, 178	105-160, 136	65-100, 88	60-80, 74	0.53-0.60, 0.55	3.31-3.99, 3.49	3.76-4.09, 3.99
P_3	670-890, 790	580-790, 696	410-560, 490 (3)	220-330, 280 (3)	190-290, 243 (3)	95-160, 132 (3)	65-95, 83 (3)	0.71-0.72, 0.71	2.55-2.91, 2.68 (3)	2.96-3.05, 3.00 (3)

Hypopygium (similar to *A. elachistus,* Fig. 1 a). As in generic description; with or without anal point (Figs. 1 e–h)

Female Imago (n = 5)

Color. Similar to male.

Length. Total 1.67–2.19 mm (2). Thorax 0.74–0.87, 0.82 mm (4). Abdomen 0.93–1.35 mm (2).

Head. Setae: temporal 20–23, 22 (3); clypeal 15–16, 16 (3); cibarial 4 (3). Palpomere lengths: 28–35, 31 (3); 38–42, 39 (3); 105 (2); 110–118 (2); 167 (1). AR 0.47–0.53, 0.49 (4).

Thorax. Setae: acrostichals 9–12, 10 (4); dorsocentrals 24–40, 34; scutellars 7–11, 10; prealars 4.

Wing. Length 1.56–1.73, 1.63 mm; width 0.57–0.61, 0.59 mm. VR 0.76–0.79, 0.78. Setae: $R+R_1$ 21–26, 23; R_{4+5} 25–41, 31.

Legs. Palmate sensilla chaetica: 19–24, 22 on middle metatarsus; 17–24, 20 on hind metatarsus. Lengths and proportions of legs (4):

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5	LR	BV	SV
P_1	550-620, 580	460-580, 531	495-575, 543	240-280, 263	170-215, 189	110-145, 121	80-90, 86	0.95-1.22, 1.03	2.15-2.71, 2.52	1.80-2.33, 2.09
P_2	660-760, 709	545-645, 591	300-330, 313	150-170, 158	110-125, 116	70-85, 75	60-75, 69	0.51-0.55, 0.53	3.81-3.90, 3.86	4.02-4.26, 4.16
P_3	680-820, 751	620-750, 691	430-525, 483	245-355, 289	200-230, 216	105-120, 111	80-100, 89	0.69-0.70, 0.70	2.47-2.88, 2.73	2.95-3.02, 2.99

Abdomen. Notum 163–173, 168 (3); cerci 85–93, 90 (3) long. S VIII with 5 setae/side (3); T X with 15–22 (2) setae; Gc IX with 1 seta/side (2). DmL, VlL and ApL as in Figs. 2 c, d.

Pupa: (n = 9)

Color. Clear with pale yellow-brown borders.

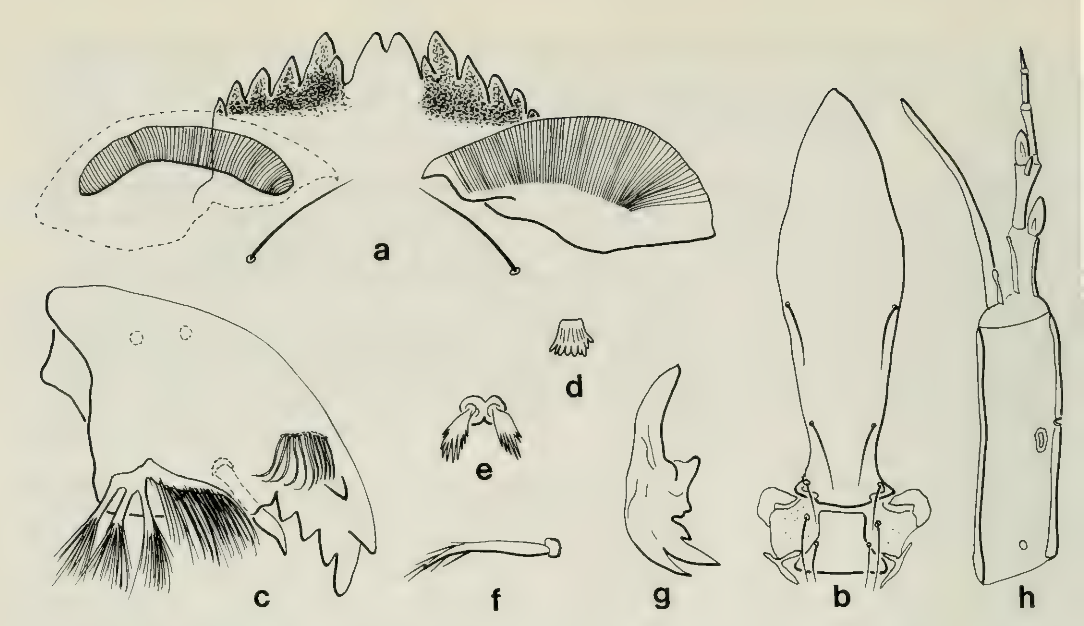


Fig. 4. Larva. *A. elachistus:* a. mentum, maxillary plate striae (left), ventromental plate striae (right); b. frontoclypeal apotome; c. mandible; d. pecten epipharyngis; e. S I; f. S II; g. premandible; h. antenna.

Length. Total 2.56–3.14, 2.88 mm (5). Cephalothorax 0.74–0.93, 0.80 mm (5). Abdomen 1.81–2.79, 2.20 mm (6).

Abdomen (Fig. 3c). Shagreen as in generic description. Posterior margin of T II with transverse row of 20–35, 28 hooklets. T VIII with 5 lamellar lateral setae, one of which is usually narrower than the others; occasionally some setae are bifid (Figs. 3f–h). Caudolateral spurs on T VIII (Figs. 3f–h) a comb of small spines. Anal lobes with 20–28, 24 setae. DR 1.63–3.29, 2.22.

Fourth instar Larva: (n = 6)

Color. Head capsule light yellow.

Head. Postmentum length 116–148, 133 (5). Mandible length 108–133 (3). Pecten mandibularis composed of 9–11, 10 setae. Mentum with 68–96, 80 (4). Ventromental plate with smooth anterior margin; width 71–87, 82 (5); length 37–44, 42 (4); VPR 1.97–2.21, 2.06 (4); IPD 16–25, 22 (4); PSR 3.28–4.44, 3.72 (4); 110–125, 118 maxillary plate striae. Length of antennal segments (5): 59–79, 69; 15–17, 16; 16–18, 17; 14–19, 16; 8–10, 9 (4); 5–6, 6 (4). AR 0.91-1.13, 1.00 (4). Frontoclypeal apotome similar to *A. elachistus* (Fig. 4b).

Remarks.

Townes (1945: 33) stated that the genitalia of *A. subcinctum* were similar to *A. elachistus* except for the presence of an anal point and "the slightly longer superior appendage". Measurements of the length and width of the superior volsellae revealed no significant differences between the 2 species in the length or width of the superior volsellae.

The male's anal point may be present or absent. Sublette (1960: 202) believed that the presence or absence of an anal point was due to differences in mounting technique. I have found that this generally is not the case with this species. Although the anal point, when present, may be dislocated laterally due to cover slip pressure (Fig. 1g), many specimens I examined possessed no anal point (Figs. 1e, f). No differences were noted in the immature stages associated with males with or without anal points. Darby (1962) encountered pointless males in his study and considered them to belong to *A. elachistus;*

however, the lack of wing spots, as noted by Darby, and the illustrated pupal T VIII spurs (Darby 1962: fig. 137) identify his specimens as *A. subcinctum.*

Although Darby (1962: fig 136a) illustrated a pupal thoracic horn with 6 branches, I have not been able to discern more than 4 branches on the thoracic horn of either *A. subcinctum* or *A. elachistus.*

Magy et al. (1970) have noted that at times of peak emergence, *A. subcinctum* can be considered a pest species.

Townes (1945) also recorded this species from its type locality in Reno, Nevada.

Material examined: Canada: ONTARIO: Marmora, 1-VII-1952, J. Vockeroth, 3 males (CN). Mexico: JALISCO: Guadalajara, Zucht aus Springbrunnen, 15-V-1981, leg. H. Fittkau, 1 male/Pex, 2 Pex (ZS). U.S.A.: ARIZONA: Coconino Co., Lake Elaine nr Flagstaff, light trap, 15-X-1986, K. Brenneman & H. Speidel, 2 males (JE). CALIFORNIA: Imperial Co., Hot Mineral, pool from hot spring overflow, 29-III-1967, leg. R. Soroker & G. Grodhaus, 1 male/Pex, 1 pharate male pupa/Lex, 2 larvae (GG); Lassen Co., 3 mi. SE Johnstonville, reared from *Typha* leaf, leg. G. Grodhaus, 1 male, 1 female, 1 pharate male pupa/Lex, 2 Pex, 1 larva (GG); Merced Co., Los Banos Reservoir, 1-V, 28-VII-1968, E. W. Mortenson, 3 males (GG); San Luis Obispo Co., San Luis Obispo, Laguna Lake, 30-VII-1964, 1 female (GG); same locality, 20-VII-1966, leg. G. Grodhaus, 1 male, 1 pharate male pupa (GG); same locality & collector, 26-VIII-1965, 1 pharate male pupa, 1 larva (GG); same locality, light trap, 8-IX-1965, leg. J. Montez, 2 males (CN); Solano Co., Vallejo, Lake Dalwigk, 2 males, 3 females, 2 larvae (GG). KANSAS: Barber Co., North Elm Creek, 12.0 mi. N, 7.0 mi. W of Medicine Lodge, 10-VIII-1981, leg. J. Gelhaus, 1 male (KS); Montgomery Co., Verdigris River, 3.0 mi. E, 2.5 mi. S of Independence, 23-VIII-1980, leg. J. Gelhaus, 1 male (KS). NEW MEXICO: Albuquerque, drainage ditch nr Rio Grande, 20-IV-1967, 1 male/Pex/Lex (CN).

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Denopelopia atria, a new genus and species of Pentaneurini (Diptera: Chironomidae: Tanypodinae) from Florida

By **Selwyn S. Roback** and **Robert P. Rutter**

Abstract

The larva, pupa and ♂ and ♀ adults of a new genus of Pentaneurini, *Denopelopia* n. gen. and *Denopelopia atria* n. sp. are described from Florida. Comparison is made with the genera *Pentaneurella, Monopelopia, Telmatopelopia, Krenopelopia, Xenopelopia,* and *Zavrelimyia.* To date, this species is known only from the type locality, a *Typha* sp. – choked drainage ditch in southwest Florida. The larvae are tolerant of extended periods of low dissolved oxygen and relatively high iron concentrations, and consume chironomid larvae, naidid worms, ploimate rotifers and diatoms.

Introduction

The new genus and species herein described were collected and reared by Mr. Rutter from a small ditch near the Florida Department of Environmental regulation (FDER) laboratory in Punta Gorda, Florida. The specimens listed are in the collections of the Academy of Natural Sciences of Philadelphia. Additional material is in the Punta Gorda FDER laboratory. Most of the specimens are slide mounted, those in ethanol are indicated by (Alc.) under *specimens examined.*

Abbreviations and Terminology

The following abbreviations and terminology are used in the descriptions, figures and tables. With some exceptions they follow Saether (1980). The ♀ genitalic terminology is after Saether (1977). The adult wing venation and pupal abdominal setae follow Fittkau (1962), the pupal thoracic setae follow Coffman (1983) and the ventral head setae, Kowalyk (1985). The measurements of the ligula and the ratio of the inner and mesal teeth to the outer teeth are illustrated in Roback (1985, Fig. 86). L and W are used to indicate length and width.

Adult

A. I–X, abdominal segments
AR, antennal ratio
Ce, cerci
Csa, coxosternapodeme A. IX, ♀ genitalia
F, femur
Gc, gonocoxite, ♂ genitalia
GCa, gonocoxapodeme VIII, ♀ genitalia
Gp, gonapophysis A. VIII. ♀ genitalia
Gs, gonostylus, ♂ genitalia
HR, hypopygium ratio Gc/Gs
LR, leg ratio Ta_1/Ti
NO, notum, ♀ genitalia
R, rami, ♀ genitalia
SCa, seminal capsules, ♀ genitalia
SDu, spermathecal duct, ♀ genitalia
Ta_{1-5}, tarsal segments
Ti, tibia
I–II, pro, meso-, metathoraic legs

Pupa

A. I–VIII, abdominal segments
Aet, aeropyle tube of respiratory organ
AL, anal lobes
ANi, apical nipple, respiratory organ
D_{1-5}, dorsal abdominal setae
Dcs 1, 2, 4, dorsocentral thoracic setae
$L_{1,2}$ lateral abdominal setae
LS_{1-5}, lateral filaments, abdomen, AL
GS, genital sacs
O_d, O_v, anterior setae, abdomen
$V_{1,2}$ ventral abdominal setae

Larva

a–e, apical palpal sensillae
aa, antaxial seta of lacinia
A_{1-4}, antennal segments
AB1, accessory blade
AeT, aeropyle tube
ANi, apical nipple
AR, antennal ratio A_1/A_{2-4}
Bl, blade
BR, basal ring of Bl
CS, campaniform sensillum
IC, head ratio $^W/L$
Lc, lacinia
LCh, lacinial chaeta
Li, ligula
pa, paraxial seta of lacinia
Pl, paraligula
PH, pecten hypopharyngis
S_{1-3}, lateroventral mandibular setae
S_{9-10}, genal setae
SP_2, sensory pegs A_2
SSm, setae submenti
VP, ventral pore

Denopelopia gen. nov.

Type species, *Denopelopia atria* spec. nov., by present designation

Diagnosis

Adult – AR 1.6–1.7; ♂ antenna with 14 flagellomeres, ♀ with 11; verticals and orbital setae in simple row (Fig. 9); wing densely haired with slight pattern in both sexes (Figs. 11, 12); costa not extended beyond R_{4+5} (Figs 11–13) ends between apices of M and CU_1 (Figs. 11, 12); m–cu close to r–m (Fig. 14); tibial spurs with elongate apical tooth (Figs. 1–3) more than half the length of the

Table 1. Comparison of some characters of *Denopelopia* (D) with those of *Pentaneurella* (P), *Monopelopia* (M), *Krenopelopia* (K), *Xenopelopia* (X), *Telmatopelopia* (T) and *Zavrelimyia* (Z). C = concave, E = even, I = inner, OU = outer, + = present, – = absent.

	P	M	K	X	T	D	Z
Adult							
AR	1.0	1.0	1.4	1.5-1.8	1.6	1.6-1.7	2.0
Produced Costa	?	-	+	-	+	-	+
end of Costa	?	Cu_1<> M	> M	Cu_1<>M	= M	Cu_1<>M	= M
T.IX setae	-	+	+	-	+	+	+
Gc, basidorsal lobes	-	-	-	+	+	_	-
Pupa							
RO L/W	3.0	5.2	3.0	5.0	5.0	11.0	4.0-5.0
distinct ANi	-	-	-	-	-	+	-
long Aet	-	-	-	-	-	+	-
no. LS.VII	4	4	3	4	4	3	4
♂GS/AL	0.66	>1.00	0.75	0.80	0.66	0.52	1.00±
AL spines	I-OU	OU	-	OU	OU	OU	I-OU
Sticky sheath LS, AL	-	-	-	+	-	+	+
Larva							
SP_2 sessile	+	+	+	+	+	+	-
CS,A_1 position	<0.5	0.5-0.6	0.6-0.7	0.5	0.5	0.6	0.6
apices of Li Teeth	C	C	C	E	E	E	E
no. Pl teeth	2	2	2	2	2	3	2
no. PH teeth	15	7	11	10	9	11	15

entire spur in length; claws sharp; ♂ genitalia simple (Fig. 18); tergite A. IX with transverse row of setae; anal point conical; hypopygium ratio about 1.6; goncoxite without internal lobes; L/W >2.00; ♀ genitalia (Figs. 15, 16); anterior end of notum slightly expanded; notum/rami 1.4; coxosternapodeme 1X curved, broadened mesally; gonocoxapodeme VIII very poorly developed; gonapophysis VIII rounded somewhat triangular; labia bare.

Pupa – Wholly brown; respiratory organ elongate with apical nipple (Figs. 20–22) and small plastron plate; respiratory atrium with constrictions, about 11 times as long as greatest width; distinct thoracic comb present (Fig. 32) Dcs 1 very short with apparent apical points (Fig. 25); scar A. I distinct, pigmented in shape of inverted T; shagreen of abdomen, short scattered spinules (4 μm); venter, A. II with arcs of combs (Fig. 28); D setae appear shaped as in Fig. 24; A. VII with three LS filaments, A. VIII with five (Fig. 29); anal lobes elongate-triangular (Fig. 29) with a row of spinules on outer margin only (Fig. 30); ♂ genital sacs about half as long as anal lobes (Fig. 29); LS filaments of anal lobes with sticky sheaths (Fig. 29).

Larva – Body of instar IV red, instar III more orange; head IC ratio about 0.50; lauterborn organs (SP_2) on A_2 sessile (Figs. 35, 36); ligula with all teeth fairly even in length (Fig. 41); paraligula trifid (Fig. 41); posterior prolegs with two smaller claws with large inner spurs (Fig. 39) and some outer pectination; medium claws (Fig. 39) with a single small inner spine; all claws (14) pale; anal tubules (Fig. 45) shorter than posterior prolegs.

Discussion

On the basis of its overall characters *Denopelopia* appears most closely related to *Telmatopelopia* Fittkau and *Zavrelimyia* Fittkau. The adult head and thoracic chaetotaxy (Figs. 6, 9) closely resemble that of *T. nemorum* (Goetg.) as figured in Fittkau (1962) Figs. 218, 219, 220. The tibial spurs (Figs. 1–3) are also close to those of *T. nemorum* as are the ♂ genitalia (Fig. 18). The wing macrotrichial pattern (Fig. 11) is similar to that of *Z. signatipennis* (Kieffer) as figured (Fig. 240) by Fittkau (1962). The pupa is very close to that of *T. nemorum* in the form of the Dcs setae (Figs. 25–27) the form of the D setae (Fig. 24) and the form and setae of the AL (Figs. 29, 30). The shape of the unusual RO of *Denopelopia* (Fig. 20) can be possibly derived by elongating the RO of *T. nemorum* (Fittkau 1962, Fig. 226) with its suggestion of an ANi. The pupa of *Denopelopia* differs in having a distinct thoracic comb (Fig. 32) and only three LS on A. VII (Fig. 29). The larval Li (Fig. 41) is close to that of *Zavrelimyia* and *Telmatopelopia* but the trifid Pl is distinct from either of those genera. The two claws of the PP with large inner spurs (Fig. 39) resemble those of *Zavrelimyia.* The latter genus has none to only one claw of that form. *Telmatopelopia* possesses several pectinate claws on the PP.

The sessile SP_2 (Fig. 36) would superficially appear to relate *Denopelopia* to *Pentaneurella* Fittkau & Murray, *Monopelopia,* Fittkau, *Krenopelopia* Fittkau, *Xenopelopia* Fittkau, and *Telmatopelopia* Fittkau. However, as noted above, the only one of those genera to which it appears more clearly related on the basis of other characters is *Telmatopelopia. Zavrelimyia* lacks the sessile SP_2. Table 1 compares some of the characters of all those genera with those of *Denopelopia* and will serve to help differentiate them.

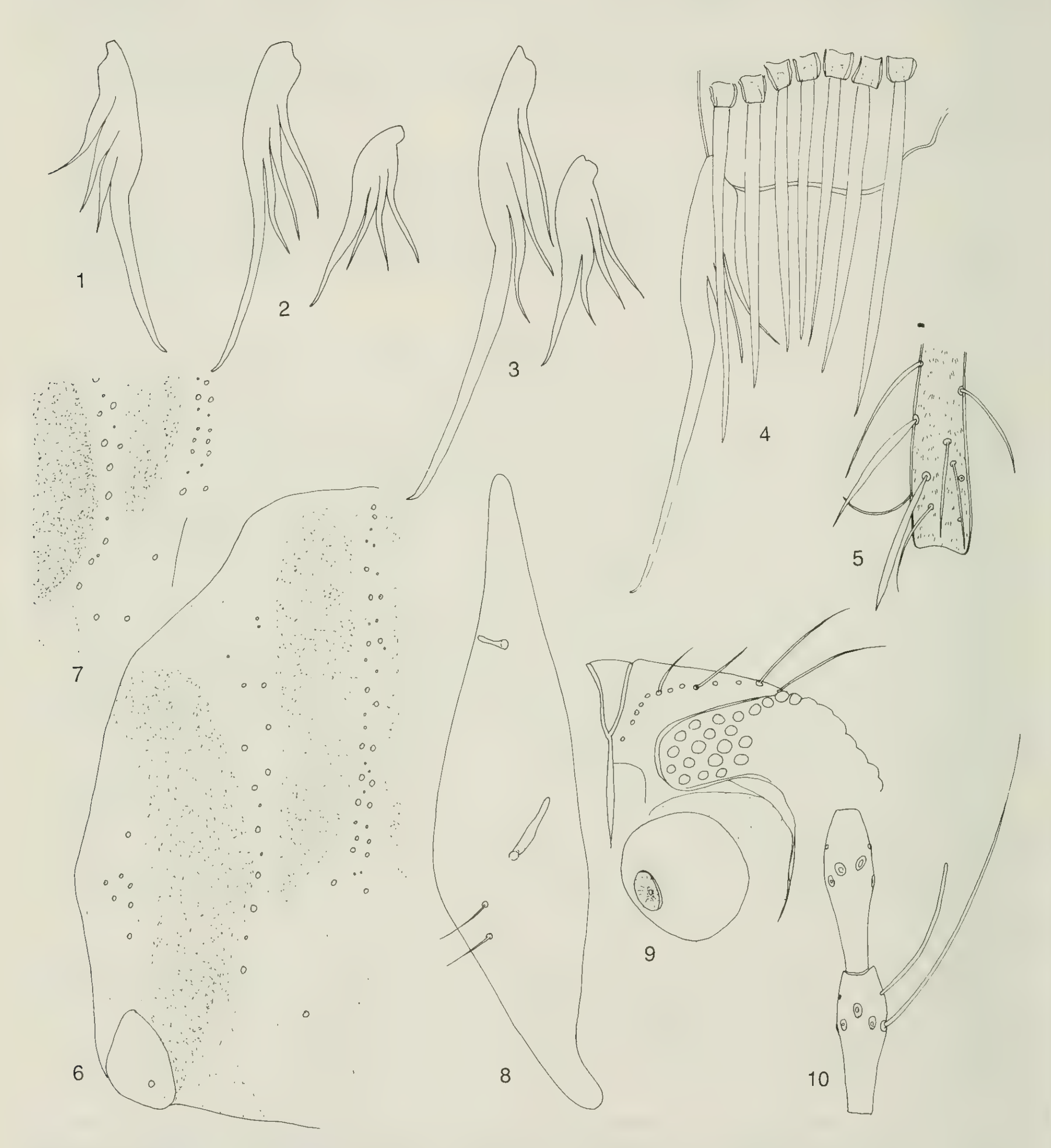
The ♀ genitalia of *Denopelopia* (Figs. 15–17) will key to *Zavrelimyia* in Saether (1977), differing in the slightly expanded anterior end of NO and the broader R of Gp IX. The other characters in Saether's description of the *Zavrelimyia* ♀ genitalia fit *Denopelopia* closely. The ♀ genitalia of *Telmatopelopia* as described by Rodova (1971) and cited by Saether (1977) possess only two seminal capsules.

Geographically *Denopelopia* poses somewhat of a problem. *Telmatopelopia* has not been to-date recorded from either the Nearctic or Neotropical Regions. The presence of *Denopelopia* in southern Florida would suggest a Neotropical derivation. This is possible, inasmuch as the Neotropical fauna is still very poorly known. *T. nemorum* has been found only in the western Palaearctic.

Denopelopia atria spec. nov.

In the following descriptions, unless otherwise indicated, the n for th x̄ in the ♂ adult = 4 and for the pupa and larva = 5.

Adult ♂ – head brown; eyes bare; outer verticals 107 μm long, uniseriate; orbitals uniseriate extend to center of dorsal eye extension (Fig. 9), 63 μm long; pedicel with five setae, 141 μm diameter (Fig. 9), pedicel 1.41× interocular space; AR 1.63–1.71 (x̄ 1.683); flagellomere 14, 80 μm long with



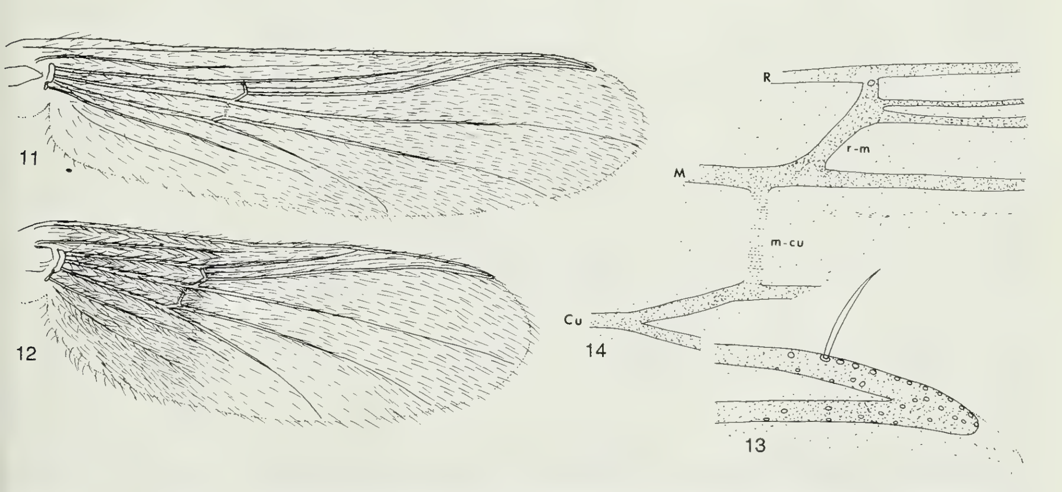
Figs 1–10. Adult. 1. spur, tibia I; 2. spurs, tibia II; 3. spurs, tibia III; 4. comb, tibia III; 5. apex of Ta_2 II; 6. scutum, male, dorsal view; 7. apices of dorsocentrals and acrostichals, female; 8. antepronotum, lateral view; 9. anterior view of male dorsal eye extensions and head setae; 10. flagellomeres 8 and 9, female antenna.

Table 2. The range of and x̄ of the leg segment measurements μm and LR for adult ♂ and ♀ *Denopelopia atria*, x̄ in parentheses, n = 3.

♂	F	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	636-722 (673.3)	677-833 (762.2)	592-707 (661.3)	318-370 (351.3)	266-322 (299.7)	181-204 (192.3)	89-107 (96.3)	0.85-0.88 (0.867)
P_2	699-792 (698.0)	629-751 (701.7)	496-555 (534.0)	237-278 (261.7)	162-222 (192.0)	103-130 (117.0)	78-89 (82.7)	0.74-0.79 (0.763)
P_3	629-722 (674.7)	803-940 (879.3)	666-755 (715.3)	352-407 (386.3)	248-300 (281.3)	148-181 (169.0)	78-104 (91.7)	0.80-0.83 (0.813)

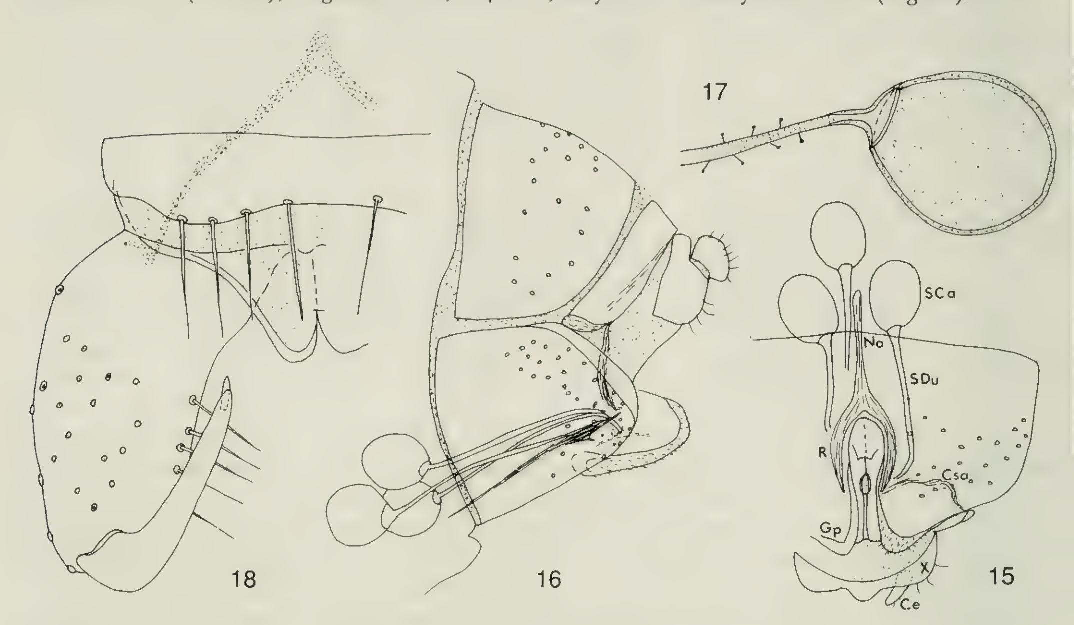
♀	F	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	592-622 (608.3)	703-777 (734.0)	570-599 (581.0)	307-315 (312.3)	233-252 (244.3)	155-167 (167.7)	93-100 (96.3)	0.77-0.82 (0.793)
P_2	685-770 (725.7)	681-740 (713.0)	459-496 (477.3)	241-266 (249.3)	163-167 (165.7)	107-118 (112.0)	89-93 (90.3)	0.66-0.67 (0.667)
P_3	629-692 (655.0)	870-932 (909.0)	629-648 (640.3)	333-370 (354.0)	241-274 (260.3)	148-167 (159.3)	89-100 (94.0)	0.70-0.72 (0.707)

preapical seta 61 μm L; clypeus with 22 long setae; palpus segments in ratio 26, 78, 141, 170, 301 μm; campaniform sensillum ventral on segment 3; antepronotum (Fig. 8) with 2–3 antepronotals and an upper (15 μm L) and lower (32 μm long) membranous projections; scutum (Fig. 6) pale brown; vittae, episterna, postnotum, bare, dark brown; scutellum paler brown; 9–12 setae on disc + 15 anterior smaller setae; three humerals; dorsocentrals irregularly uniseriate (Fig. 6); acrostichals biseriate, extend to caudal end of median vittae; a single seta mesal and behind dorsocentrals; six-nine prealars and one supra-alar; wing (Fig. 11) with overall hair pattern, slightly paler mesally; length 1.6–1.7 mm; costa not produced (Fig. 13) ends between M and Cu_1; R_2 not present; m–cu 0.30 arculus to wing tip; crossvein area of wing as in Fig. 14; legs pale, unmarked; leg measurements and ratios in Table 2; ratio of longest hairs of Ti, $Ta_{1,2}$ to mesal segment width in Table 3; slight beard present on $Ta_{2,3}$ I; hairs on Ti, Ta_1 II, III longer than on I; spur Ti I 48–54 μm L with three lateral teeth (Fig. 1); spurs Ti II



Figs. 11–14. Adult. 11. male wing; 12. female wing; 13. detail of apex of costa, female wing; 14, detail base of radial sector and r–m, m–cu crossveins.

57–58 and 31–35 μm long with three lateral teeth (Fig. 2); spurs Ti III 73–77 and 34–35 μm long with three lateral teeth; comb Ti III (Fig. 4) of seven setae; pseudospurs on Ta_1, Ta_2 (Fig. 5) and $Ta_{3,4}$ II; none could be discerned on leg III; abdomen with A. I–III pale; basal third of A. IV brown; A. V–VIII wholly brown; A. IX with 8–10 setae; A. X conical, membranous; genitalia as in Fig. 18, pale; Gc 118–126 μm L ($\bar{x}$ 124.0); Gc length/width 2.00–2.27 ($\bar{x}$ 2.133); Gs 74–81 μm L ($\bar{x}$ 77.8); HR 1.45–1.70 ($\bar{x}$ 1.598); megaseta of Gs, 11 μm L; only strut 3 clearly discernible (Fig. 18).



Figs. 15–18. Adult genitalia. 15. female, ventral view; 16. female, lateral view; 17. detail of seminal capsule and duct; 18. male, dorsal view.

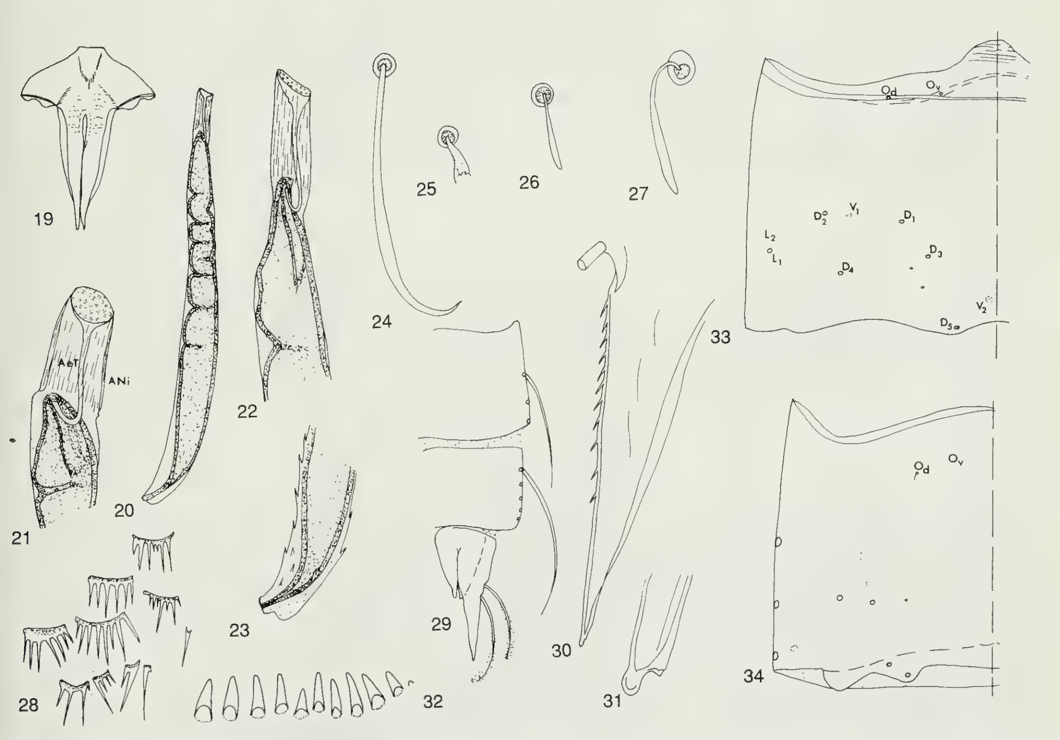
Adult ♀ – Head verticals and orbitals as in ♂; pedicel with 6–7 setae; scape with 4–6 setae; pedicel 81 μm diameter, equal to interocular space; antenna with 11 flagellomeres; flagellomere 1 73–76 μm L; flagellomeres 2–4, 44–51 μm long; flagellomeres 5–8, 55–61 μm L; flagellomeres 9–10, 64–70 μm long; flagellomere 11 145–146 μm L with 115 μm preapical seta; flagellomeres 8, 9 as in Fig. 10; basiconic sensillum 73 μm long; clypeus and palpus as in ♂; antepronotum and scutum marked as in ♂; 8–11 humerals; 8–12 prealars; dorsocentrals extended caudad as are acrostichals (Fig. 7); 10 scutellars across disc; postnotum as in ♂; wing 1.30–1.33 mm; wing venation as in ♂; hairs in basal third of wing denser and darker (Fig. 12); apex of C and R_{4+5} (Fig. 13); legs as in ♂, unmarked; tibial spurs and comb III as in ♂; leg measurements and ratios in Table 2; longest hairs on $Ta_{2,3}$ I not longer than those on II and III (Table 3); hairs on Ti and Ta_1 II, III longer than those on Ti, Ta_1 I as in ♂ (Table 3); abdomen wholly brown; genitalia as in Figs. 15, 16; SCa (Fig. 17) pale

Table 3. Ratio of longest hairs/mesal segment width for ♂ and ♀ Ti, and Ta_{1-3}, all legs, *Denopelopia atria*.

♂	Ti	Ta_1	Ta_2	Ta_3	♀	Ti	Ta_1	Ta_2	Ta_3
P_1	4.40	4.62	7.33	6.50	P_1	3.75	3.71	3.43	2.85
P_2	6.00	5.29	4.50	3.83	P_2	6.00	5.00	3.14	2.71
P_3	8.00	7.69	3.83	6.00	P_3	6.67	6.00	5.43	3.57

brown, 63×55 μm; L/W 2.25; SDu (Fig. 17) thin walled with special secretory cells; NO 108 μm L, slightly widened anteriorly; R 77 μm (Fig. 15); NO/R 1.40; Gca VIII poorly developed; Csa IX curved, slightly broadened mesally (Figs. 15, 16); gonocoxite IX small; gonotergite IX well developed, bare, appears transversely striate; Gp VIII apically rounded, somewhat triangular (Fig. 15) labia bare; X with three-four setae on each side (Figs. 15, 16), Ce (Figs. 15, 16) 63×55 μm; L/W 1.15; Sca/Ce 1.40; Sca/NO 0.58.

Pupa — Exuviae including wing pads medium to dark brown; frontal apotome as in Fig. 19; respiratory organ (Fig. 20) elongate, narrow with a distinct apical nipple (Figs. 21, 22); overall length of respiratory organ 480—533 μm (x̄ 508.0); respiratory atrium with variable constrictions; 432—480 μm long (x̄ 460.8); L/W 10.7—11.5 (x̄ 11.14); greatest width of respiratory atrium 0.37 from its base; apical nipple, lightly sclerotized, 66—76 μm L (x̄ 70.0); L/W 2.22—3.46 (x̄ 2.586); aeropyle tube with bend toward base (Figs. 21, 22); overall 61—67 μm L (x̄ 64.2); plastron plate (Fig. 21) ovoid, 15—16 μm L (x̄ 15.3, n = 4); L/W 0.53—0.79 (x̄ 0.643, n = 4); base of respiratory organ with small surface spines (Fig. 23); a distinct thoracic comb of 10—11 short conical tubercles present (Fig. 32); precorneal setae not clearly discernible; dorsocentral setae in Figs. 25—27, Dcsl, short with 3,4 points, 9 μm L (Fig. 25); Dcs2 (Fig. 26) 20 μm L; Dcs4 (= Sas) 27 μm L (Fig. 27); scar A. I distinct, pigmented in the form of an inverted T; abdominal shagreen of scattered fine spinules about 4 μm L; venter of A. II with arcs of spinule combs, 5—12 μm L (Fig. 28); A. I with three D setae; A. II and A. VII (Fig. 34) with four D setae; A. III—VI (Fig. 33) with five D setae; L_1 appears present on A. I—VI; L_2 on A. I—VII; $V_{1,2}$ on A. III—VII; almost aligned and close together on A. VII (Fig. 34); arrangement of D, L, V setae of A. V shown in Fig. 33; D setae appear shaped as in Fig. 24; most D setae distorted in mounting; on



Figs. 19—34. Pupa. 19. frontal apotome; 20. respiratory organ; 21. detail of apex of respiratory organ, dorsal; 22. detail of apex of respiratory organ, lateral; 23. detail of base of respiratory organ; 24. seta D_3, A. IV; 25. seta Dcsl; 26. seta Dcs2; 27. seta Dcs4 (= Sas); 28. ventral combs of A. II; 29. A. VII, VIII and anal lobes; 30 detail of anal lobe; 31. detail apex of anal lobe; 32. thoracic comb; 33. setal pattern of A. V; 34. setal pattern of A. VII.

A. V D_2 73 μm L; D_3 (Fig. 24) 51 μm L; D_5 24 μm L; O_D and O_V in anterior segment margins (Fig. 33); on A. VII (Fig. 34) O_D, O_V distinctly caudad of anterior margins; anterior of A. III–V produced strap-like (Fig. 33) with transverse grooves; A. VII with three LS filaments about 348 μm L (Fig. 29); filaments placed at 0.47, 0.74, 0.94 from base to apex of segment; A. VIII with five LS filaments about 481 μm L (Fig. 29); filaments placed at 0.28, 0.54, 0.72, 0.87; 0.98 from base to apex of segment; on some specimens L_1 of A. VI is enlarged into filament 222 μm L; anal fins elongate. triangular (Fig. 29) with row of 9–13 spinules (Fig. 30) on outer margin; spinules 8–9 μm L; anal lobes 344–418 μm L ($\bar{x}$ 387.8); L/W 3.21–3.64 ($\bar{x}$ 3.492); lateral filaments of anal lobes with sticky sheaths (Fig. 29); LS_1 about 222 μm L placed at 0.39–0.42 ($\bar{x}$ 0.408) from base to apex of anal lobes; LS_2 about 259 μm L placed at 0.49–0.52 ($\bar{x}$ 0.506) base to apex of anal lobes; apex of anal lobes knob-like (Fig. 31); ♂ genital sacs, slightly narrowed apically; 0.49–0.55 ($\bar{x}$ 0.523, n = 3) length of anal lobes; ♀ genital sacs 0.26 ($\bar{x}$ 0.275, n = 2) length of anal lobes.



Figs. 35–45. Larva. 35. apical antennal segments; 36. detail of apex of A_2; 37. maxillary palpus and apical sensillae; 38. detail of lacinia of maxilla; 39. smaller claws of posterior prolegs; 40. mentum; 41. ligula, paraligula and pecten hypopharyngis; 42. ventral head setal pattern; 43. detail of lateroventral mandibular setae; 44. detail of apex of mandible; 45. anal tubules, lateral view.

Larva — Head pale brown; length 739—749; IC 0.51; depth/length 0.52; labrum similar to *Ablabesmyia* (Roback, 1985, Figs. 11, 12); S_9, S_{10}, SSm and VP (Fig. 42) similar to *Monopelopia* (Kowalyk, 1985); A_1 300—318 μm ($\bar{x}$ 307.8); CS, A_1 0.55—0.61 ($\bar{x}$ 0.570) from base; A_2 94—100 μm (Fig. 35) ($\bar{x}$ 96.7, n = 3); L/W A_2 about 12; A_3 4 μm; A_4 4—5μm; AR 2.75—2.91 ($\bar{x}$ 2.846); Bl and ABl (Fig. 35) subequal in length to A_{2-4}; Bl/A_{2-4} 0.95—0.98 ($\bar{x}$ 0.963, n = 4); Bl 100—111 μm ($\bar{x}$ 104.8, n = 4); ABl 102—111 μm ($\bar{x}$ 105.8, n = 4); basal ring (BR) 24 μm L; L/W 3.00 (Fig. 35); sensory pegs (Lauterborn organs) of A_2 4—5 μm L; sessile on apex of A_2 (Figs. 35, 36); blade of A_2 (Fig. 35) about 7 μm L; mandible 107—122 μm; lateroventral setae (S_{1-3}) as in Fig. 43; S_1 short and peg-like; inner teeth and seta subdentalis (Fig. 44); apical tooth of mandible about 0.30 length of mandible and 2.75 as long as width at base; A_1/mandible 2.57—2.80 ($\bar{x}$ 2.656); palpus (Fig. 37) 44—47 μm L ($\bar{x}$ 45.0); L/W 4.43—5.17 ($\bar{x}$ 4.758); CS of palpus 0.64—0.71 from base ($\bar{x}$ 0.690); apical segments of palpus (b) and sensillae (a, c, d, e, f) shown in Fig. 37; lacinia as in Fig. 38 with border of LCh; antaxial seta and paraxial setae on membranous projections, simple (Fig. 38); A_1/palpus 6.45—7.07 ($\bar{x}$ 6.848); ligula (Fig. 41) 77—78 μm ($\bar{x}$ 81.8); inner and mesal teeth appear slightly paler; inner teeth and mesal tooth 1.00—1.02 length of outer tooth ($\bar{x}$ 1.012); paraligula trifid (Fig. 41); 44—45 μm L ($\bar{x}$ 44.4); first inner tooth apex at about 0.75 base to apex; second inner tooth apex 0.65 base to apex; pecten hypopharyngis with 11—12 teeth (Fig. 41); mentum as in Fig. 40; pseudoradula slightly broadened basally, pustules random; M appendage and ventromentum clearly separated, laterally separation appears partially sclerotized with alveoli (Fig. 40); two dorsomental teeth present; body red in fourth instar, more orange in third; anterior prolegs about 469 μm L, fork about 0.76 of their length from base; claws 29—58 μm L, simple; those under 29 μm with 1—3 fine inner spines; procercus 159—170 μm ($\bar{x}$ 163.8, n = 4); L/W 4.74—5.38 ($\bar{x}$ 5.000, n = 4); with seven apical elongate setae; two lateral setae below procercus; upper simple, 38 μm; lower multibranched, 92 μm; supraanal setae about 350 μm L; three lateral setae below supraanal seta, upper bifid 114 μm; mesal seta simple 27 μm; lower bifid 54 μm; subbasal seta of posterior prolegs simple, about 230 μm L; claws of posterior prolegs pale brown; two shortest claws (Fig. 39) with strong inner teeth and some spinules on outer margins, three slightly larger claws with one small internal spine (Fig. 39); nine longer teeth narrow, finely pectinate; anal tubules as in Fig. 45; upper about 192 μm L; lower 155 μm; both slightly more than 4 times as long as greatest width.

Specimens examined

Holotype — ♂ pupal exuviae-adult, shallow ditch near FDER laboratory, Punta Gorda FL, VII-1986, coll. Rutter.
Allotype — ♀ pupal exuviae — adult, same data
Paratypes — 5♂♂, 3♀♀ pupal exuviae — adult, same data; 3♀♀ pupal exuviae — adult, same data (Alc.)
Non-types — 12 larvae; 4♂♂, 3♀♀ pupae, same data: 19 larvae; 2♂♂, 3♀♀ pupae, same data: (Alc.).

Habitat, Ecology and Rearing

To date this midge is known only from the type locality, a shallow drainage ditch surrounding the Punta Gorda Branch Office of the Florida Department of Environmental Regulation (FDER) in Charlotte County. Charlotte County lies in the transition zone between the humid subtropical climate that prevails over much of the southeastern United States and the quasi-tropical climate of southernmost Florida. Freezing temperatures are rare. Rainfall averages between 127 and 140 cm per year. Although some rainfall normally occurs every month, there is a distinct rainy season extending from May through September and a low rainfall season from October through April. About 60 to 65 percent of the annual rainfall occurs during the late spring-summer rainy season (Fernald & Patton 1984, p. 179).

The 3 m wide ditch, at least 12 years old, was constructed to aid in stormwater drainage but has water yearround due to groundwater seepage. Ditchbank vegetation includes cinnamon fern *(Osmunda*

cinnamomea), royal fern *(O. regalis* var. *spectabilis),* water primrose *(Ludwigia* sp.), wax myrtle *(Myrica cerifera),* exotic Brazilian pepper *(Schinus terebinthifolius),* swamp willow *(Salix caroliniana),* southern fox grape *(Vitis munsoniana),* and south Florida slash pine *(Pinus elliottii* var. *densa).* Emergent species are cattail *(Typha* sp.), present throughout the ditch, duck-potato *(Sagittaria lancifolia)* and pickerelweed *(Pontederia lanceolata).* Overstory canopy is restricted to the shoreline, but the dense growth *Typha* sp. effectively shades much of the open water areas.

The pupae and adults were reared from fourth instar larvae collected in mid-July and early August 1986. A D-frame aquatic dip net was pulled swiftly backward along the bottom among the cattails producing currents which suspended the surficial detritus, then the direction was rapidly reversed and the mouth of the net bag was pushed forward through the incoming water. In this manner about 24 larvae were collected with a minimum of debris from an area of approximately 3 m^2.

Water depth in the area where *D. atria* larvae were collected was 613 cm and water movement was barely perceptible. The bottom was 34 cm of accumulated leaf and needlefall from riparian and emergent vegetation, overalain by an orange floc. Values for selected physicochemical parameters measured at this location at a depth of 4 cm on 14 July 1986 were: temperature 27.5C, specific conductance 370 μmhos/cm, pH 7.1, dissolved oxygen 0.3 mg/l, Fe 1.2 mg/l. On 19 December 1986 values were: 21.5 C, 345 μmhos/cm, 7.1, 0.6 mg/1 and 2.8 mg/l, respectively. An iron concentration of 108 mg/l was recorded for a floc sample collected from the bottom on 22 December 1986.

Midges coexisting with *D. atria* in August were *Chironomus* sp., *Goeldichironomus holoprasinus* (Goeldi) and *Zavreliella varipennis* (Coquillett); in December were *Chironomus* sp., *Einfeldia austini* Beck & Beck and *Tanypus carinatus* Sublette. Larvae of the phantom cranefly, *Bittacomorpha* sp., were also present in both months. Gut contents of 15 slide-mounted *D. atria* larvae included *Chironomus* sp. larvae, naidid worm setae, unidentified arthropod parts, the ploimate rotifer *Lecane* sp., a variety of pennate diatoms *(Achnanthes* sp., *Cymbella* sp., *Gomphonema* sp., *Navicula* spp., *Nitzchia* spp., *Pinnularia* sp.) and undifferentiated detritus.

Fourth instar larvae were held communally in a 5.0×8.5 cm clear glass container filled with 75 ml of ditchwater, several detrital willow leaves and floc. In the rearing container larvae clung either to the underside of the willow leaves or to the small irregular clumps of floc/fine detritus. The larvae readily pupated and each pupa was placed in to a 17×60 mm 2dram clear glass vial containing 4 ml (depth 25 mm) of ditchwater and either a toothpick or willow leaf extending through the air/water interface. Pupae typically assumed a "C" configuration against the submerged portion of the leaf or stick, and often times were observed with the respiratory organs against the water surface. When prodded they were strong swimmers. However, all pupae died within 36H, some in the process of eclosion. Subsequently all but 3 mm of water was drained from the vials and some willow leaf fragments were placed on the bottom. This worked nicely and several adults emerged successfully. It appears that the pupa of this species may leave the water partially or entirely at some time prior to ecolosion.

A multitude of habitats and water quality conditions in southwest Florida rivers, streams, canals, lakes and ponds have been sampled for benthic macroinvertebrates since 1980 as part of the FDER water quality monitoring program, but not a single specimen of *D. atria* has been collected. This suggests restrictive ecological requirements for the species, most likely the larval stage. FDER sampling in ditches is rate, but such habitats are not uncommon in southwest Florida. Ditching to improve drainage for pastureland, cropland and residential developments has been and still is extensively employed. Southwest Florida has an extensive surficial aquifer system (Fernald Patton 1984, p. 36), and in Charlotte County the water table may be at or above land surface for months in poorly drained areas. Many wells that tap this aquifer in the central portion of the county produce water with more than 2 mg/l of iron (Sutcliffe 1975). According to Wolansky (1978) a significant but unknown amount of discharge from this unconfined aquifer is into canals and drainage ditches. Further collecting in ironrich groundwater seeps may reveal additional populations of *Denopelopia atria.*

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Morpho-karyological description of Euryhapsis subviridis (Siebert) from the South of the Soviet Far East

(Diptera, Chironomidae)

By **E. A. Makarchenko, J. J. Kiknadze** and **J. E. Kerkis**

Introduction

The species *Euryhapsis subviridis* (Siebert) belongs to the primitive Orthocladiinae including also chironomids of the genera *Eurycnemus* Wulp, *Xylotopus* Oliver, *Brillia* K. and *Irisobrillia* Oliver (Oliver, 1981, 1982, 1985; Oliver & Roussel, 1983). Out of the genera given, only species *Brillia* and mainly *B. longifurca* K.[1] and *B. modesta* Mg. (Pankratova, 1970; Shilova, 1976) are widespread over the USSR. In addition to representatives of this genus (*B. flavifrons* Joh., *B. modesta, B. laculata* Oliver & Roussel[2], we have found two species of *Euryhapsis* Oliver: *E. cilium* Oliver and *E. subviridis* (Siebert) in the Soviet Far East, the metamorphosis of the latter being examined from larva to imago and the larvae fixed for karyoanalysis.

Chironomids of the genus *Euryhapsis* which is new to the USSR fauna at all stages of development are close to *Brillia,* however they can be easily recognized by the structure of male hypopygium (wide transverse sternapodeme, distomedial lobe of gonostylus with 2 terminal and few subterminal lamellate macrosetae and shorter than subapical lobe, by structures of pupa sternites (sternites VII–VIII each with a posterior row of spines on low protuberance) and by antenna structure of larva (the 2nd segment is never divided into 2 parts).

There are detailed descriptions of the preimaginal stages in *E. cilium* and imago of North America and Mongolia (Oliver, 1981) whereas *E. subviridis* was identified by the only male from Austria (Siebert, 1979). That is why the present work deals with description of larva and pupa of this species as well as the re-description of a male obtained in the Soviet Far East. As the larvae of *Euryhapsis* are poorly distiguished by their external morphological characters we considered it necessary to carry out the karyological analysis of *E. subviridis* and to give the first description of its karyotype demonstrating the photomap of the polytene chromosomes as well as to present information about the chromosome polymorphism in the Sakhalin population studied.

Karyotype analysis has contributed much to our current knowledge of the taxonomy and evolution on *Chironomidae* (Keyl, 1961, 1962; Martin et al., 1974; Martin, 1979; Wülker & Butler, 1983; Belyanina et al., 1983). The karyotypes of more than 130 species of the subfamily Chironominae have been most extensively studied. Based on karyological data, the taxonomic position of many species was made more precise, a number of new ones described (among which of particular interest are the sibling-species), and the phylogenetic relation of the species to each other were established (Keyl,

[1] In our opinion *B. longifurca* Kieffer, 1921 should be considered as a synonym of *B. flavifrons* Johannsen, 1905 because the male hypopygium of these species are identical.

[2] Previously this species was known only from North America (Oliver & Roussel, 1983).

1962; MARTIN, 1979; WÜLKER & BUTLER, 1983; DÉVAI et al., 1983; RYSER et al., 1983; KIKNADZE & KERKIS, 1984, 1986). Other subfamilies, however, in particular Diamesinae and Orthocladiinae, have been less studied on karyological grounds. At present the number of Orthocladiinae species studied is just 40 or so, Diamesinae – about 7 (KUBERSKAYA, 1974, 1979, 1984; MECHELKE, 1953; MICHAILOVA, 1976, 1980, 1985; PETROVA, 1983), and this is clearly insufficient for a general consideration of the karyosystematics of the entire Chironomidae family.

Materials and methods

Material for morphological studies of *E. subviridis*: 2♂♂, Primorye, Khasan Region, Barabashevka River, 17.VII.1975 (E. Makarchenko); 1♂, Primorye, Dalnegorsky Region, Inza River, 1.X.1983 (E. Makarchenko); 1♂, ibid., Partizansk Region, Partizanskaya River, 18.V.1984 (E. Makarchenko); 1♂, Sakhalin Island, Tym River, 18.IX.1979 (E. Makarchenko); 20♂♂, 13♀♀, 8 pupae, 12 larvae, ibid., Sokol Village, 18.VII.1986 (E. Makarchenko). Larvae and pupae were fixed by 70% ethanol and imagines by Udemans solution.

Terminology and abbreviation to A. I. SHILOVA (1976) and SAETHER (1980).

The larvae for karyological analysis were fixed in 3:1 ethanol-acetic acid and stored in a refrigirator. Analysis was performed on squashed spreads of salivary gland polytene chromosomes prepared by the standard aceto-orcein technique. The gonads and the imaginal discs stained with aceto-orcein were used for the meiotic and mitotic metaphase chromosome spreads. Determination of larvae age was based on the morphology of the imaginal discs according to WÜLKER & GÖTZ (1968). The total number of larvae studied was 28.

Euryhapsis subviridis (Siebert) comb. nov.

SIEBERT, 1979: 167–168 *(Brillia)*

Male (n = 8).

Total color greenish-white or yellowish white. Head brownish or reddish, eyes black, antenna brownish, thorax yellowish or greenish. Legs white or greenish, spurs of tibia black. Length, 4.5–5.9 mm; TL/WL 1.4–1.7.

Head. Verticals, 13–25; postorbitals, 6–11; clypeals, 11–28. AR 1.58–2.27. Length of last four maxillary palp segments (μ): 55–75.8; 250–345; 160–244; 157.5–247.5.

Thorax. Antepronotum with 3–6 dorsomedial and 8–16 ventrolateral antepronotals. Dorsocentrals, 36–55; prealars, 11–21; supraalars, 1; scutellars, 34–36.

Wing with micro-and macrotrichias. Length, 2.7–3.8 mm. Squamal setae, 9–51.

Legs. LR_1 0.86–0.88; LR_2 0.55–0.59; LR_3 0.57–0.75; SV_1 2.0–2.1; SV_2 3.5–3.74; SV_3 2.49–2.98; BV_1 2.17–2.38; BV_2 2.8–3.48; BV_3 2.61–2.72. Hind tibial comb consisting of 8–9 spines.

Hypopygium (fig. 1 A–H). Tergite IX with 12–28 setae; sternite IX laterally with 4–9 setae. Gonocoxite parallel-sided, without stout setae on dorsomedial margin. Superior volsella with 18–30 setae (about 30 μ of length). Distomedial lobe of gonostylus about three-quartes as long as subapical lobe and with 2 terminal and 6–8 subterminal lamellate macrosetae. Transverse sternapodeme square to rectangular with a truncated apex.

Pupa (n = 6)

Colour grey or dark grey, anal lobe yellowish or greyish; length, 6.3–8 mm. Exuviae grey.

Thoracic horn brownish-yellow or yellow; large, pointed and covered with spinules only in the upper three quarters (fig. 2A). Length of thoracic horn 481.4–572.7 μ; ratio of length of thoracic horn to width of thoracic horn 5.2–6.9.

Tergites II–V each with rough shagreen on all surface (fig. 3D); tergite VI medial with tender shagreen only. Tergites II–VI each with posterior row or rows of spines (fig. 3C, E). Tergites VII–VIII

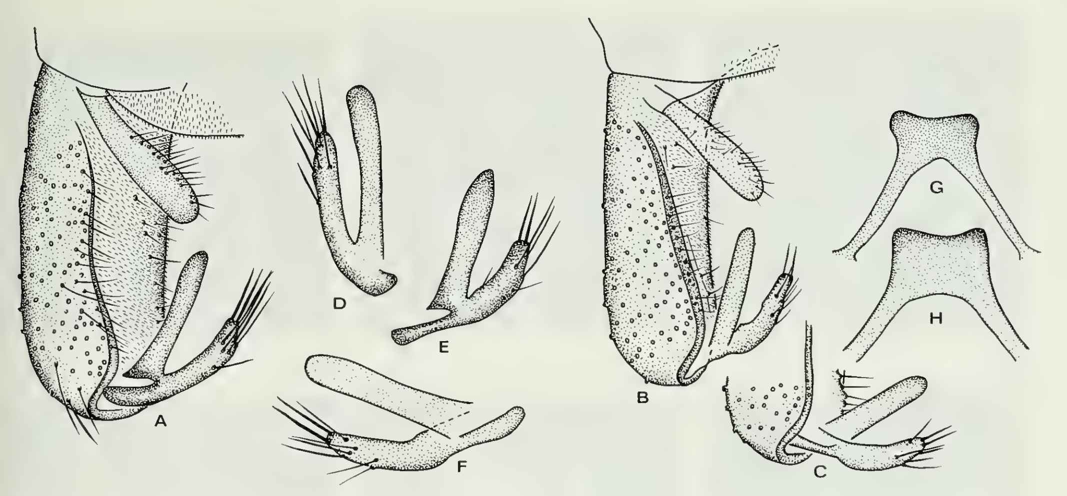


Fig. 1. Male of *Euryhapsis subviridis:* A–C – hypopygium (A – from Sakhalin Island, B–C – from Primorye), D–F – gonostylus, G–H – transverse sternapodeme (G – from Primorye, H – from Sakhalin Island).

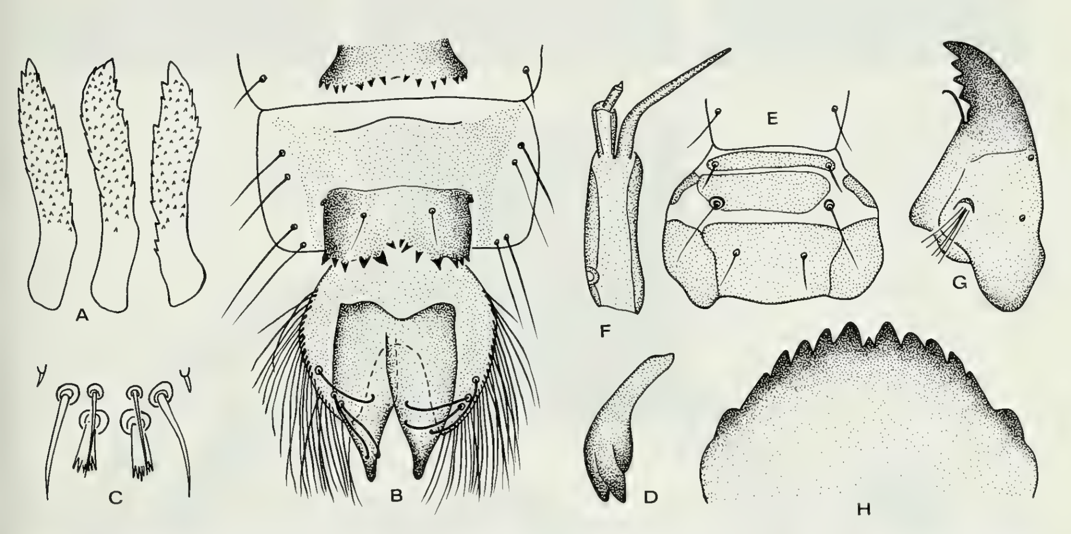


Fig. 2. Pupa (A–B) and larva (C–H) of *Euryhapsis subviridis:* A – thoracic horn; B – segments VII–IX of male, ventral; C – SI–SIV setae of labrum; D – premandible; E – frontal apotome, clypeus, and labral sclerites; E – antenna, G – mandible, H – mentum.

without shagreen and posterior rows of spines. Sternites II–III each with very tender anterior shagreen only. Male sternites VI–VIII each with a posterior row of spines, on low protuberance on VII (fig. 3F) and two low protuberance on VIII (fig. 2B); female sternites VI–VII similar to male, and two large, flap-like protuberance on VIII (fig. 3G). Number of spines of posterior row of sternites VI–VIII: 14–17; 13–14; 10–16. Conjuctives II/III–IV/V with spinules (fig. 3A–B). Segments II–VIII each with 4 L-setae; length of lateral setae of segments I–V 105.6–132 μ, of segments VI–VIII 161.7–264 . Anal lobe with complete lateral fringe of 26–34 setae and 3 anal macrosetae (fig. 2B).

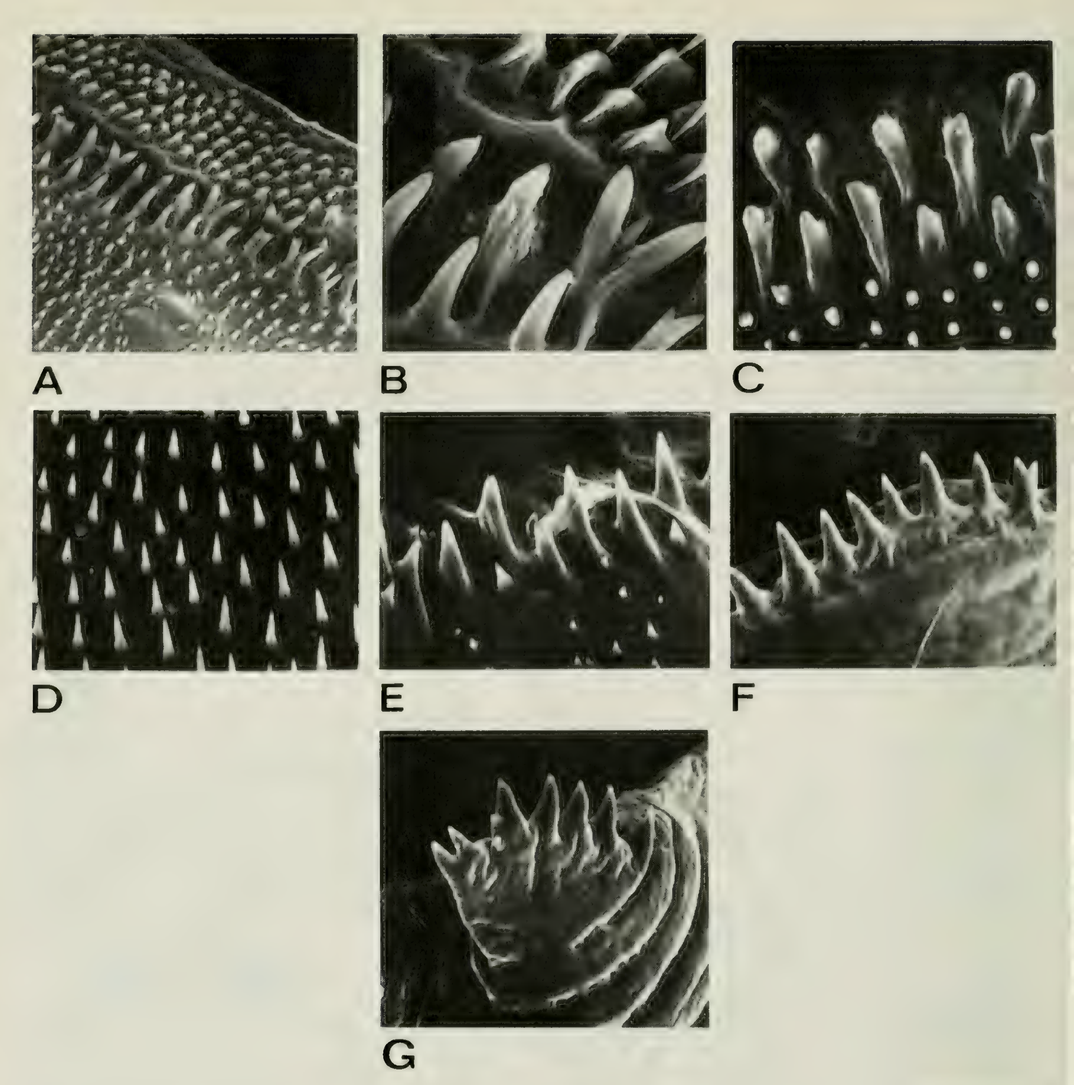


Fig. 3. Structures of tergites and sternites of pupa *Euryhapsis subviridis:* A – posterior row of spines tergite II and conjuctives II/III, ×275; B – ibid, ×525; C – posterior rows of spines tergite III, ×525; D – shagreen of tergite III, ×525; E – posterior row of spines tergite VI, ×525; F – posterior row of spines sternite VII, ×275; G – posterior row of spines sternite VIII of female, ×275.

Larva, fourth instar (n = 6)

Colour white or greenish; length, 8.2–8.9 mm. Head capsule yellow, width of head 0.4–0.5 mm; eye spot, apical half of mandible and mentum black.

Labrum granular on lateral; labral sclerites as on fig. 2E. S I setae of labrum distal plumose, S II–SIII simple, S IV present, but very small (fig. 2C).

Antenna yellowish-brown, 4-segmented; ring organ near base of first segment; antennal blade about 1.5–1.6 times as long as combined length of flagellar segments (fig. 2F); AR 1.63–1.95. Premandible distal with 3 teeth (fig. 2D).

Mandible with 5 teeth; basal tooth blunt and shorter as other inner teeth. Seta subdentalis long, apically slightly curved, ending at level of apex of second inner tooth; seta interna with 5 plumose branches (fig. 2G).

Mentum with one median tooth and 6 pairs of lateral teeth present; sixth lateral tooth lower as other lateral teeth (fig. 2H).

Procercus about 1.5–1.6 times as long as wide, posterior part strongly sclerotized; bearing 8 apical and 2 subapical anal setae, the lowest of them about 2–3 times as long as the upper one.

Oecology

Larvae inhabit the low course of foothill rivers on gravel-pebble grounds with sandy filling at the rate of 0.5–0.7 m/s.

Karyological analysis of larva of fourth instar

Observation of the diplotene nuclei and mitotic metaphases (of imaginal disc mitoses) in *E. subviridis* show three pairs of very small chromosomes (fig. 4a). Because of the somatic pairing characteristic of Diptera, the homologues lie close to each other, and the number of chromosomes discernible at the mitotic metaphase often appears to be three. Judging by the morphology of the metaphase chromosomes, two pairs are metacentrics, and the third one is submetacentric. As expected from the mitotic arrangement, in the salivary gland nuclei there are three chromosomes, each of them exhibits two paired homologues (fig. 4b). The chromosomes have been numbered I to III in order of decreasing length and tentatively given left and right ends. The major division has been numbered consecutively throughout each chromosome, and each major one subdivided into minor ones denoted by letters (fig. 5). *E. subviridis* polytene chromosomes have distinctive banding patterns making them advantageous for karyological analysis. However, we encountered difficulties when attemping to identify the centromeres because there were no associated large blocks of heterochromatin. We succeeded in defining the

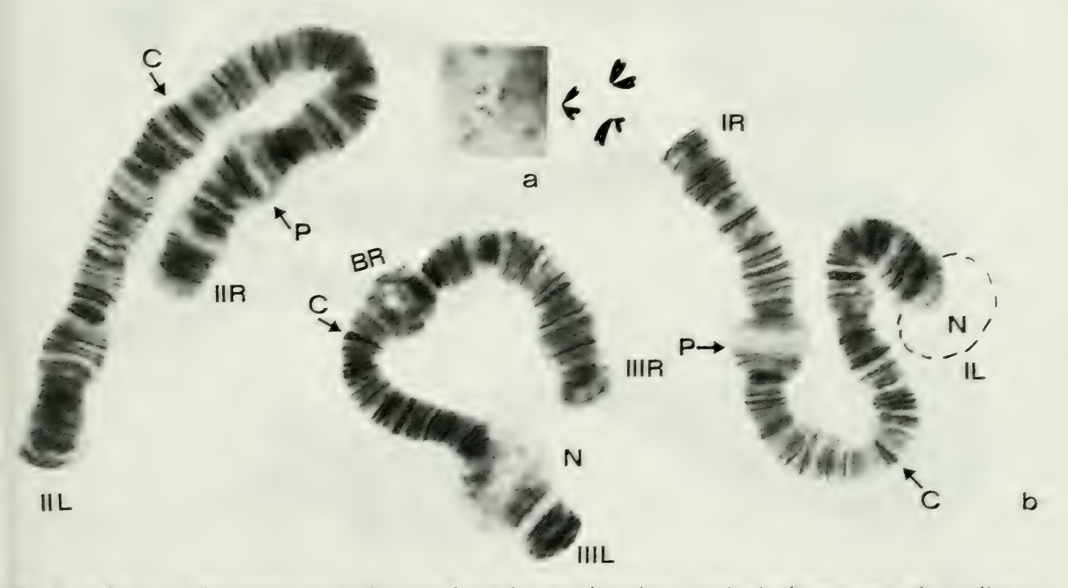


Fig. 4. The entire chromosome complement of *Euryhapsis subviridis*. a – mitotic chromosomes; b – salivary gland polytene chromosomes. IL–IR; IIL–IIR; IIIL–IIIR – chromosome arms. The arrows indicate the putative candidates for the centromeric bands. N – Nucleolar organizer, BR – Balbiani ring.

centromeric regions only after thoroughly examining of many preparations. The bands we thought to represent the centromeric regions in all the larvae studied were distinguished from all other bands of the polytene chromosome by their homogenous staining.

Chromosome I (175± 5.2 μ) is the longest of the complement. It is a metacentric chromosome containing section 1–21. The centromeric region is identified in section 9/10. A characteristic feature is the presence of a nucleolus at the end of arm IL in section 1. Reviable markers of arm IL are the constrictions in sections 3 and 8 as well as dark bands in sections 4, 6 and 7. Such markers in arm IR are the constriction in section 10, heavy bands in sections 16, 17 and 18. A prominent puff develops in some larvae in section 15. Heterozygous inversions in arm IL were detected only in one larvae of all those examined (fig. 6a).

Chromosome II (168 ±8 μ) is nearly as long as chromosome I. It is a metacentric like chromosome I (fig. 5). It consists of 21 sections. The centromeric region shows two dark bands in section 10/11. Arm IIL is distinguished by the presence of constriction in sections 2 and 4, clear-cut banding in section 5 and pale bands in section 8; arm IIR has a constrictions in section 11, bands distinct in sections 12, 13 and 15). There is a small puff in section 20 in all the larvae studied, and also in sections 10 and 18 in some (fig. 4–5). No nucleoli and Balbiani rings were identified in chromosome II, neither were rearrangements.

Chromosome III (152± 4.5 μ) is the shortest of the complement, and it is divided into 17 sections. It is a submetacentric (fig. 4–5). The centromere was deduced by the presence of a dark band in section 10. There is a Balbiani ring near section 9 of arm IIIR and a nucleolus in section 15. The main markers

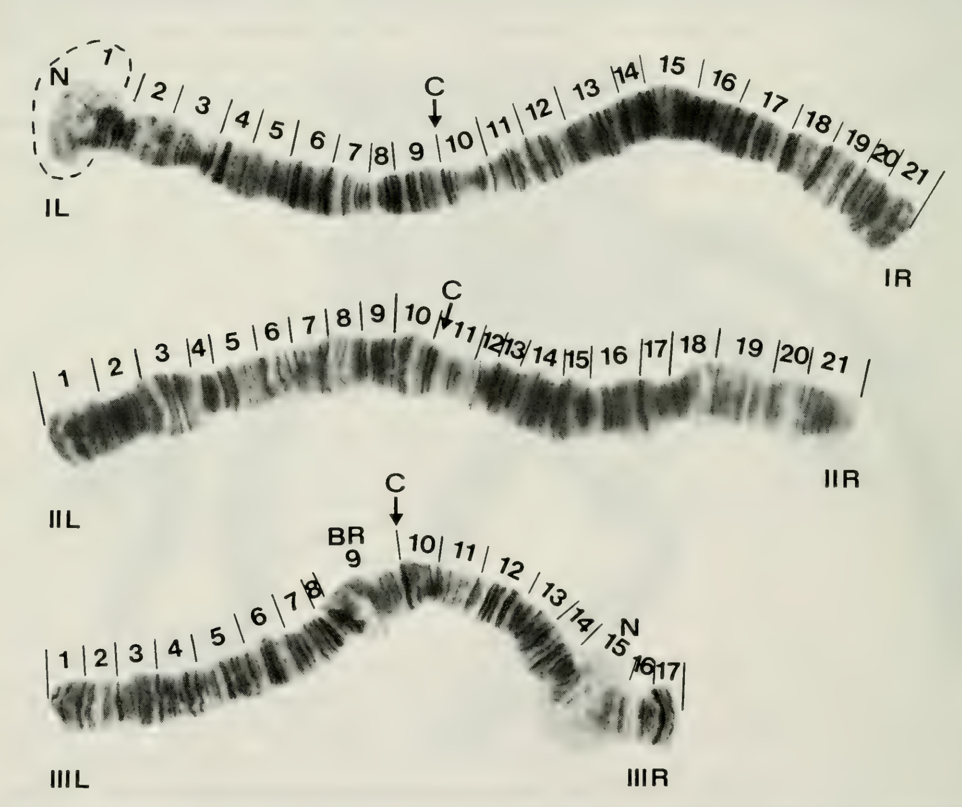


Fig. 5. A standard map of the salivary gland chromosomes of *Euryhapsis subviridis*. The designations are the same as in fig. 4.

of arm IIIL are groups of bands in sections 4, 5, 6, 7 and 8; and those of arm IIIR are groups of pale bands in section 11 and dark ones in sections 12 and 17 (fig. 5). Heterozygous inversions were observed in both arms in 33 % of the larvae (fig. 6).

The distinctive morphological features of the salivary gland of *E. subviridis* deserve some comments. The morphology of the salivary glands of some other Orthocladiinae species have been considered elsewhere (Mechelke, 1953). The salivary glands of Orthocladiinae have been described as flat sacs composed of three lobes. The glands are paired organs asymmetrically arranged in the larval body. The cell nuclei in the lobes differ in polyteny level, puffing and nucleolus patterns (Mechelke, 1953). The paired salivary glands of *E. subviridis* are sacshaped too. One gland is elongated and the other is ovoid. In *E. subviridis,* the salivary gland cells are radially arranged cells with low ploidy level lying in a semicercle closer to the centre, and the level of chromosome polyteny increases with the distance from the center (fig. 6d–e). An attempt was made to compare the polytene chromosomes from the central and peripheral parts of the salivary gland according to the activities of the nucleoli and Balbiani rings. This seemed reasonable because some Orthocladiinae species were found to differ markedly in the activities of these regions in some of the gland cells. However, no such differences were observed, so far, for *E. subviridis.*

The peripheral gland cells have the highest level of polyteny, and they are, consequently, advantageous for karyological analysis.

It has been reported that ecological and ontogenetic factors affect the structure of the polytene chromosomes (Iliinskaya, 1984; Demin & Iliinskaya, 1986). There are also indications in the literature that compactization of the salivary gland chromosomes in summer may be manifested as loss of the fine structural details. However, we have not observed that this might be the case. Although the *E. subviridis* larvae were fixed in June, the polytene chromosome retained their distinct banding patterns. The discrepance between the observations reported in the literature and ours may be due to the fact that they were made on the represent actives of different Chironomidae subfamilies.

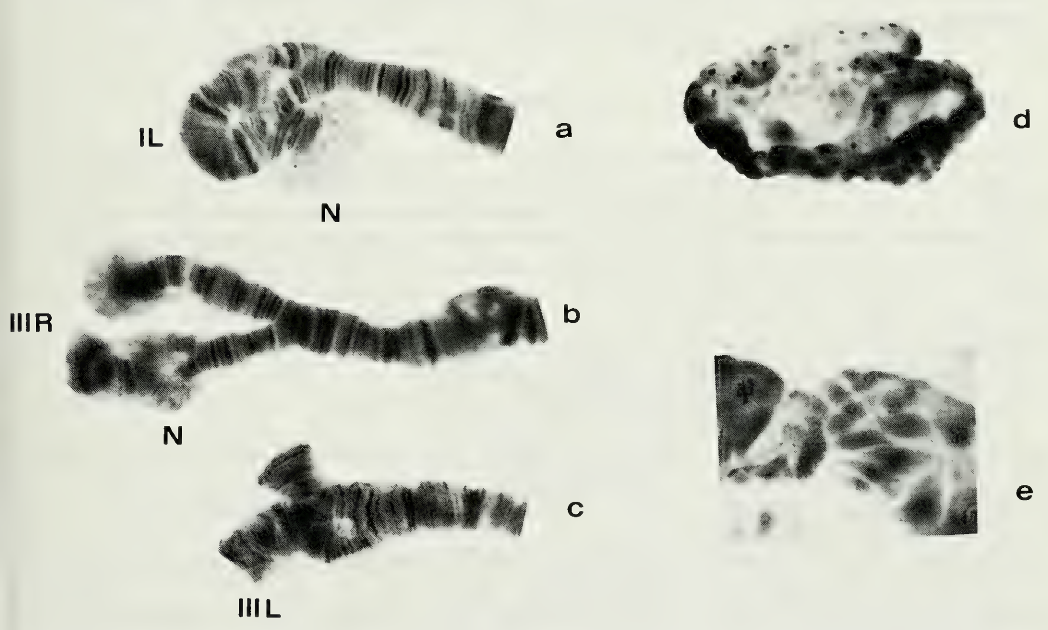


Fig. 6. Arm IL (a), arm IIIR (b), arm IIIL (c) heterozygotes. The morphology of the salivary glands of *Euryhapsis subviridis:* d – magnified part of the gland near the duct; e – general appearance. Cells with nuclei at different levels of polyteny are distinctly seen.

Notes

E. subviridis males are very close in the structure of hypopygium to the North American species *E. illoba* Ol., however they differ from it in the value of AR (AR = 1.06 in *E. illoba).* Individuals of the Far East differ also from the male of the type locality in higher values of AR and LR (AR = 1.25, LR = 0.80 in *E. subviridis* from Austria).

Within the genus *Euryhapsis* the preimaginal stages were previously known only for *E. cilium.* Pupa of *E. subviridis* differs from *E. cilium* in the form of thoracic horn which is bifurcated and totally covered with fine spinules whereas in *E. subviridis* it is simple and covered with spinules only in the upper three quarters. Larvae of *E. cilium* and *E. subviridis* are very similar and they can be distinguished only by certain characters. SI of labrum in *E. subviridis* with 7–9 lobes (more than 10 in *E. cilium),* the seta interna with 5 plumose branches (7 in *E. cilium),* the 6th lateral tooth of mentum is rounded, larger than the 5th and much lower as the other lateral teeth (the 5–6th lateral teeth of mentum of *E. cilium* are of similar shape and size and arranged close to each other).

Comparisions of the major karyotypic features of *E. subviridis* with those of the other Orthocladiinae studied demonstrate similarities with respect to diploid chromosome number (2 n = 6), location of the centromeric region (2 metacentrics, 1 submetacentric) (Michailova, 1976, 1985).

There are some karyotypic features, specific to *E. subviridis* to be noted. The level of chromosome polyteny is higher in *E. subviridis* as compared with that established for the other members of the Orthocladiinae subfamily (Michailova, 1976, 1985). This facilitates chromosome mapping in *E. subviridis.* Another specific feature of the *E. subviridis* karyotype is the unusual telocentric localization of the nucleolar organizer in chromosome I. Futhermore, its polymorphism level is 0.4 heterozygous inversions per individual, higher than reported for the other representatives of the Orthocladiinae subfamily (Michailova, 1985).

It would be of interest to study karyotypes of other species of the genus *Euryhapsis* to provide a broader bases for comparision of the structural organization of chromosomes and also to make judgements about their interrelated evolutionary history.

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The occurrence of setal tufts on larvae of Orthocladius (Orthocladius) annectens Saether

(Diptera, Chironomidae)

By **J. P. Fagnani** and **A. R. Soponis**

Abstract

Setal tufts are described and illustrated for larvae of *Orthocladius (O.) annectens* Saether. The usefulness of this character for distinguishing genera must be re-examined.

Introduction

This is the first report of setal tufts on larvae of the genus *Orthocladius*. The occurrence of setal tufts has been a traditional character for distinguishing larvae of some species of *Cricotopus* from larvae of all species of *Orthocladius*.

A setal tuft is a group of setae arising from a single base and occurring laterally in 1 to 4 pairs on abdominal segments in larvae of some Chironomidae. Although the fourth lateral seta is most often developed as a setal tuft, lateral setae 1 to 3 can also occur as setal tufts. SAETHER (1980) did not define setal tufts in his glossary.

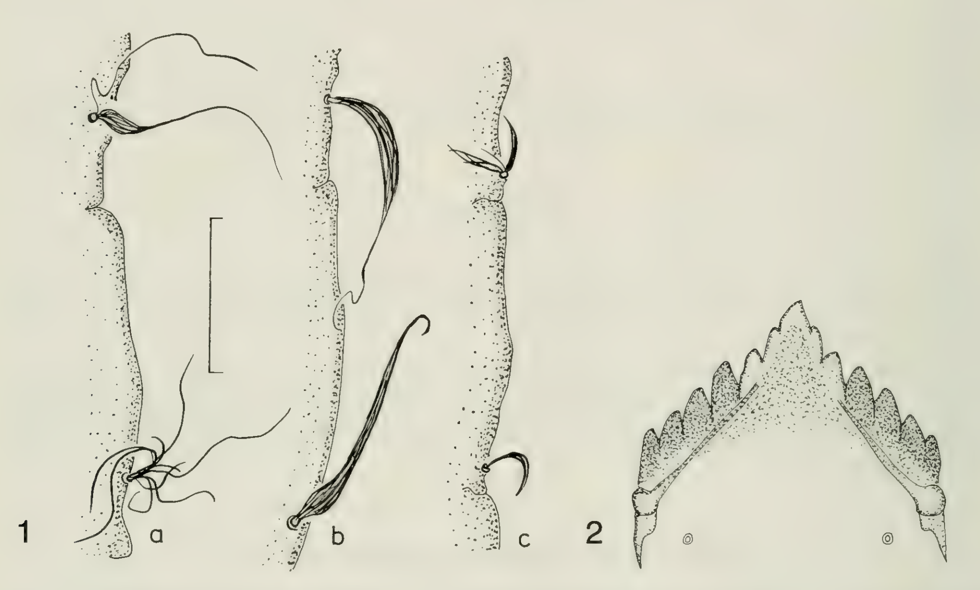
Orthocladius (Orthocladius) annectens Sæther

Larval exuviae of O. *(O.) annectens* reared from Otsego Lake, New York, possess distinct setal tufts (Fig. 1). One pair occurs on each of segments IV to IX, situated posterolaterally in place of the L4 setae. The tufts can be long and robust (Fig. 1a, b) to short and weak (Fig. 1c). Each tuft is composed of approximately 9 to 16 setae which can sometimes appear to be a single thick seta (Fig. 1a, 1c).

Setal tufts have been noted previously in three genera of Orthocladiinae: *Cricotopus, Stackelbergina*, and *Symposiocladius* (THIENEMANN 1944; CHERNOVSKII 1949; HIRVENOJA 1973; SHILOVA and ZELENTSOV 1978; CRANSTON 1982a; CRANSTON et al. 1983; OLIVER and ROUSSEL 1983). Similar plumose setae have been described in *Parorthocladius* and *Synorthocladius*. Setal tufts have been referred to as bristle tufts (JOHANNSEN 1937); hair pencils (JOHANNSEN 1937; ROBACK 1957; DARBY 1962; MASON 1973; BECK 1975, 1976; SIMPSON and BODE 1980); setal tufts (THIENEMANN 1944; CHERNOVSKII 1949; CRANSTON 1982a; CRANSTON et al. 1983); setal brushes (THIENEMANN 1944; CRANSTON 1982b; CRANSTON et al. 1983); many-branched brush setae (CHERNOVSKII 1949); hair tufts (MASON 1973); plumose setae (OLIVER et al. 1978; CRANSTON 1982a; OLIVER and ROUSSEL 1983); and group of setae (COFFMAN and FERRINGTON 1984). THIENEMANN (1944, and earlier) used both Büschelborsten (setal tufts) and Borstenpinsel (setal brushes) for these setae in *Cricotopus*.

To our knowledge there is no published record of the occurrence of setal tufts in larvae of *Orthocladius*. SAETHER (1969) originally described O. *annectens*, but he did not include body setae in the larval

description. Soponis (1977), in her redescription, did not examine body setae on the larvae, but the presence of setal tufts on those specimens was verified by D. R. Oliver (pers. comm.). Soponis (1977) correctly synonymized *Hydrobaenus* sp. 2 of Roback (1957) with *O. annectens*, but Roback reported that the unassociated larvae lacked hair pencils on the body. Simpson and Bode (1980) provided photographs of the larva of *O. annectens* (as *O. [O.]* prob. *annectens*), and stated that the larval abdomen lacked hair pencils. Presumably, the setal tufts were obscured or destroyed on the specimens examined, or these authors overlooked them. Setal tufts vary in size on larvae of *O. annectens*, and they are difficult to see on larval exuviae and larvae that have been mounted in self-clearing media for some time. In alcohol-preserved larvae, prominant setal tufts are generally visible at 25 to 50 × under a dissecting microscope, but they may be lost or obscured after slide-mounting. Roback (1957) pointed out that, „These hair pencils are often broken off in handling and mounting and must be searched for with great care".



Figs 1–2. *Orthocladius annectens* Sæther. 1 a–c: Setal tufts in slide-mounted larvae (scale = 0.2 mm). 2: Larval mentum.

Orthocladius annectens is Nearctic and is found throughout most of North America (Soponis 1977). This widely distributed species lives in small streams, large rivers, and lakes (Soponis 1977; Simpson and Bode 1980). The larvae of *O. annectens* can be distinguished from all morphologically similar species of *Orthocladius* and *Cricotopus* by the unusual 13-toothed mentum with the 5 light median teeth extended anteriorly (Fig. 2). However, because of setal tufts, the larva of *O. annectens* will key to *Cricotopus* in most recent keys (e. g., Oliver et al. 1978; Simpson and Bode 1980; Cranston 1982a; Cranston et al. 1983; Oliver and Roussel 1983; Coffman and Ferrington 1984).

The functions of setal tufts are not clear. Menzie (1978, 1981) theorized that setal tufts on *Cricotopus sylvestris* enhanced the larva's ability to stay on aquatic plants in a strong tidal current. The setal tufts could adhere to leaves, stems and filamentous algae, preventing the larva from being washed out of the vegetation. Hershey and Dodson (1984 and pers. comm.) found that larvae of *Cricotopus sylvestris*, which possess large setal tufts, were less susceptible to predation from *Hydra* than *Cricotopus bicinctus*, which possess smaller setal tufts. In addition to attachment and anti-predation, other functions of setal tufts may include floating, swimming, feeding, and antifouling.

As stated above, the occurrence of setal tufts has been a traditional character for separating the larvae of some species of *Cricotopus* from all species of *Orthocladius*. Whether setal tufts occur in other larvae of *Orthocladius* has yet to be determined.

Material examined: Rat Cove, Otsego Lake, Cooperstown, Otsego Co., New York, J. P. Fagnani: 1 male with lar. and pup. ex., Ekman grab, 10' water, 24.IV.1982; 1 pharate female pupa with lar. ex., Ekman grab, 3' water, 24.IV.1982; 1 pharate female pupa with lar. ex., Ekman grab, 8.IV.1981; pup. ex. and assoc. lar. ex., rock in 0.5' water, 25.VI.1980; 1 pharate female pupa with lar. ex., ventral surface of Nuphar variegatum leaves, 24.VI.1980; 2 pre-pup. larvae. Ekman grab, 23.V.1980; 2 mature larvae, Ekman grab, 8.IV.1981.

Acknowledgements

We would like to thank D. R. Oliver and P. S. Cranston for verifying the occurrence of setal tufts on additional larvae of *Orthocladius annectens*. This research was supported by the Biological Field Station, State University of New York, College at Oneonta; the Wadsworth Center for Laboratories and Research, NYSDH; and CSRS, USDA (FLAX 79009).

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Aquatic xylophagous Orthocladiinae – systematics and ecology

(Diptera, Chironomidae)

By **P. S. Cranston and D. R. Oliver**

Abstract

Wood-mining Orthocladiinae are reviewed. *Chaetocladius ligni*, the first xylophagous member of the genus, is described as new to science. *Symposiocladius* Cranston, erected for *lignicola* Kieffer, is synonymised with, and treated as a subgenus of, *Orthocladius* Wulp. Extensive morphological variation in *O. lignicola* is recognized and discussed. Observations on the biology of xylophagous chironomids are reviewed with suggestions for further study.

Introduction

Larval Chironomidae occur in the most diverse geographic and habitat ranges of any insect family, from high Arctic lakes, permanent montane snowfields and glaciers through temperate and tropical ecosystems to terrestrial mosses in the Antarctic. In many aquatic biotopes, chironomids may dominate in abundance and even biomass, despite their relatively small size. Studies on systematics and ecology of northern hemisphere Chironomidae have elucidated their importance in lake classification, both extant (e. g. Brundin, 1949; Saether, 1979; Wiederholm, 1976) and historic (e. g. Warwick, 1975), and allowed recognition that chironomid community structure is an integral part of environmental monitoring and assessment of lotic water quality.

A research area that has received rather less intensive study is the rôle of larval chironomids in the decomposition of aquatic immersed wood. Foremost amongst those examining invertebrates in such ecosystems is N. H. Anderson and his associates at Oregon State University. Their work has resulted in both research and review publications (e. g. Anderson et al., 1978; Dudley & Anderson, 1982) and the provision of specimens of wood-mining Chironomidae for systematic studies. This material reveals that taxonomic problems remain and there are still undescribed xylophagous species of ecological significance. We take this opportunity to describe a new species of wood-mining *Chaetocladius* Kieffer, to reassess the taxonomy of *Symposiocladius* Cranston, and to consider the range and diversity of xylophagous Chironomidae. We conclude with some observations on past studies and make suggestions for future research.

Methods and abbreviations

All new material examined is slide mounted in Canada Balsam or Euparal and deposited in the Canadian National Collection, Ottawa, Canada (CNC), unless otherwise stated. Abbreviations of other Institutes are as follows:

OSU – Oregon State University, Corvallis, Oregon, U.S.A.
BMNH – British Museum (Natural History), Cromwell Road, London, England.
MZBN – Museum of Zoology, Bergen, Norway.
USNM – United States National Museum, Washington, D. C., U.S.A.
ZSBS – Zoologische Staatssammlung, Munich, German Federal Republic.

Morphological terminology follows SAETHER (1980). Other abbreviations used in text: dc_{1-4} – Pupal dorsocentral setae; Fe – Femur; L. – Larva; Le. – Larval exuviae; L. R. – Leg ratio = Length of tarsomere 1: Length of tibia; P. – Pupa; Pe. – Pupal exuviae; pc_{1-3} – Pupal precorneal setae; Ta_{1-5} – Tarsomeres; Ti – Tibia.

Chaetocladius (Chaetocladius) ligni spec. nov.

Adult male (n = 5):

Body length 2.8–3.4 mm, wing length 1.48–1.82 mm.

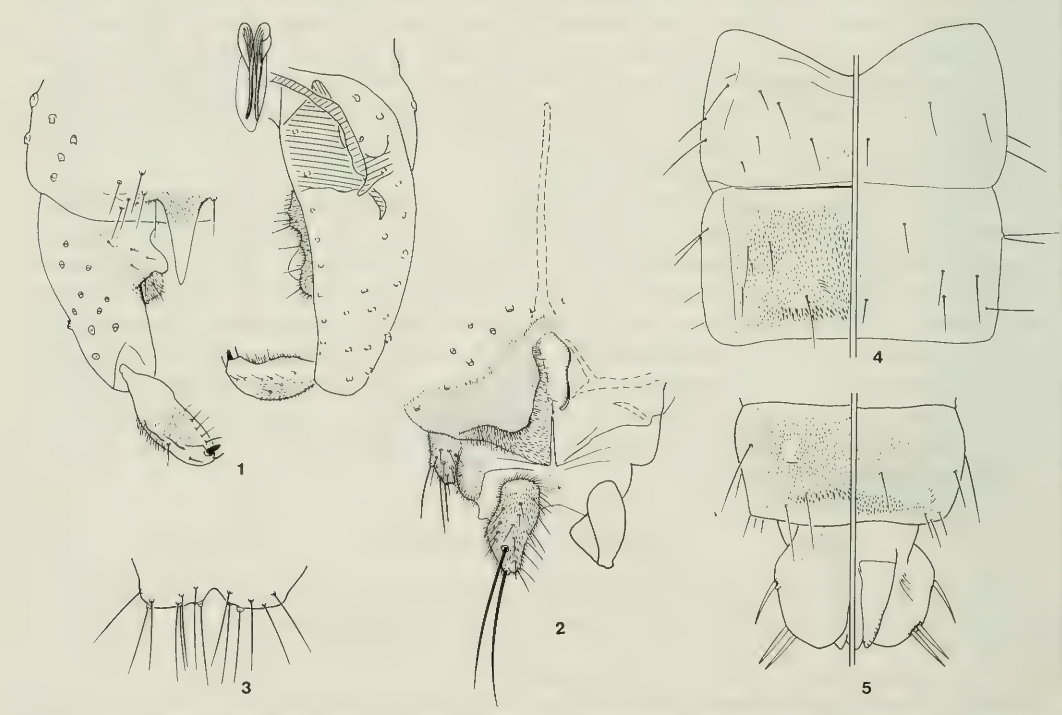
Antennal ratio 0.55–0.99, apical flagellomere 213–340 μm long. Head with 3–5 inner verticals continuous with 6–9 outer verticals and postorbitals; 7–10 clypeals; palp segment 4 shorter than 3rd and 5th segments, 5th segment longer than 3rd.

Thorax with 7–9 lateral antepronotals, 13–18 uni– to partly biserial dorsocentrals, 5–8 uniserial posterior prealars, 6–10 uniserial scutellars.

Wing with obtuse anal lobe, brachiolum with 1 setae, R with 5–21 setae, R_1 with 5–9 setae, R_{4+5} with 12–21 setae; 5–8 squamals.

Legs with pseudospurs on tarsomere 1 and 2 of mid and hind legs; tarsomere 1 of mid leg with 0 sensilla chaetica, hind leg with 0–3 sensilla chaetica on apical one-quarter and sometimes also on middle third; pulvilli small. Fore leg ratio, 0.71–0.76; mid leg ratio, 0.42–0.47; hind leg ratio, 0.55–0.58.

Hypopygium (Fig. 1) with long, narrow anal point. Virga consisting of cluster of long, dark spines. Gonocoxite with dorsal part of inferior volsella narrow, bare, apically rounded and slightly curved posteriorly; ventral part variable in shape, usually rounded, sometimes almost absent. Gonostylus with rounded outer corner and low, broad, crista dorsalis.



Figs. 1–5. *Chaetocladius ligni* spec. nov. Adult male, – 1 Hypopygium . Adult female, – 2 genitalia, – 3 tergite IX. Male pupa, – 4 segments I and II, left tergites, right sternites, – 5 segments VIII and anal end, left dorsal, right ventral.

Adult female (n = 2):

As male, except, wing length 1.66–1.82 mm.

Antenna with 5 flagellomeres, apical flagellomere with strong apical seta. Head with 11–12 temporals, 10–13 clypeals.

Thorax with 9–12 lateral antepronotals, 26–33 dorsocentrals, 8–9 posterior prealars, 9 scutellars.

Wing with obtuse (almost right-angled) anal lobe; R with 18–20 setae, R_1 with 12–16 setae, R_{4+5} with 29–30 setae; 6–9 squamals.

Legs. Tarsomere 1 of mid leg with 27 (n = 1) sensilla chaetica on distal two-thirds, hind leg with 29–32 sensilla chaetica on distal two-thirds. Fore leg ratio, 0.74–0.75; mid leg ratio, 0.41–0.45; hind leg ratio, 0.56.

Genitalia (Fig. 2) very similar to those illustrated for the genus by SÆTHER (1977, fig. 54 A–C) except concavity of distal margin of tergite IX deeper (Fig. 3). Also 2 long, strong setae arise from each cercus.

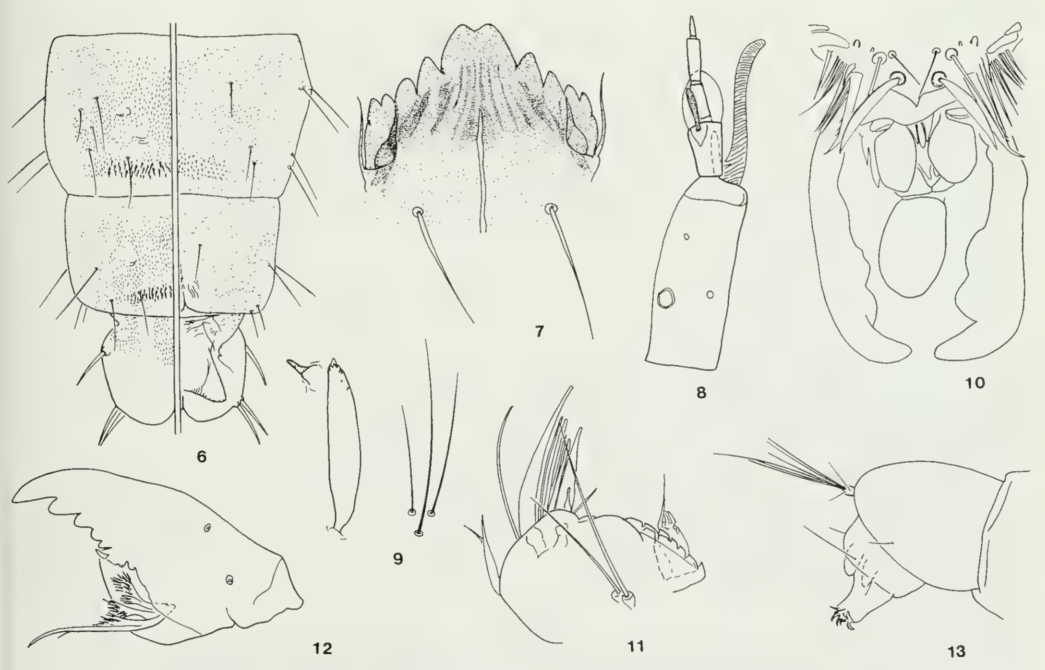
Pupa (n = 12):

Length, 2.9–3.7 mm.

Frontal apotome with small frontal seta on small cephalic tubercle.

Thoracic horn cylindrical with spinose apex (Fig. 9), 112–165 μm long. Narrow, pointed to bluntly rounded tubercle on scutum dorsomedial to base of thoracic horn (Fig. 9).

Tergites II–VIII covered with coarse spinules grading into posterior spine band; sternites with weak shagreen on II becoming more extensive and stronger on successive posterior sternites; posterior margin of sternite VIII straight with spines (♂) or bilobed without spines (♀) (Figs. 4–6). All L-setae hair-like. Anal lobe broad with outer margin up-curved; megasetae about 10× as long as wide, with middle megaseta located close to posterior megaseta (Figs. 5, 6).



Figs. 6–13. *Chaetocladius ligni* spec. nov. Pupa, – 6 female, segments VI & VIII and anal end, left dorsal, right ventral, 9 thoracic horn, precorneal setae and scutal protuberence/spine. Larva, – 7 mentum, – 8 antenna, – 10 labrum and premandibles, – 11 maxilla, – 12 mandible, – 13 anal end.

Larva, Fourth instar (n = 15):

Antenna (Fig. 8) five-segmented with segments consecutively shorter or segments 3 and 4 subequal; antennal blade ending at level of segment 5; Lauterborn's organs large, subequal in length to segment 3. Antennal ratio, 1.06–1.43 (n = 13).

Labrum (Fig. 10) with anterior part folded under frontoclypeus; SI smooth, lamelliform, S II and S III smooth, S IV consisting of 2 simple pegs; labral lamellae absent; labral chaetae and spinulae smooth with chaeta media serrate on one margin; pecten epipharyngis consisting of 3 small spines; median pair of chaetulae laterales large, rectangularly rounded, covering rest of chaetulae; chaetulae basales with bifid apex; basal sclerite large.

Premandible with 1 apical tooth and low-rounded accessory tooth; brush weak.

Mandible (Fig. 12) 144–166 μm (n = 11) long with short apical tooth and 4 inner teeth; seta interna with 5 serrate branches and 1 long smooth to serrate branch.

Mentum (Fig. 7) with long apically bifid median tooth and 4 pairs of shorter lateral teeth; lateral notch present at level of base of 4th lateral tooth; ventromental plates small.

Maxilla (Fig. 11) with weak pecten galearis.

Abdomen (Fig. 13) with preanal segment curved over remaining posterior segments; procercus with 6 anal setae, directed posteriorly.

Type-material: Holotype ♂ slide-mounted in Canada Balsam: U.S.A., Oregon: Benton County, Berry Creek, 15.X.1984 (mass reared from immersed wood) (N. H. Anderson) (CNC No. 19701). Paratypes: U.S.A., Oregon: same locality as holotype, 12.X.1982–12.XI.1984 (mass reared from immersed wood) (N. H. Anderson) (1 ♀, 2 ♂ P. with associated Le., 1 ♀ P., 11 Pe., 20L.); Crook County, Allen Creek, 26.VIII.1978 (T. Dudley) (1 ♀ P.), Ochoco Creek, IX.1978 (T. Dudley) (1 ♂); Lake County, Mack Creek, 7.VII.–28.IX.1982 (mass reared from immersed wood) (N. H. Anderson) (2 ♂♂, 1 ♂ with associated Pe., 1 ♀, 1 P., 2 L.) (BMNH, CNC, MZBN, USNM, ZSBS).

Remarks:

Adult males of *C. ligni* are similar to those of *C. melaleucus* (Meigen) (Edwards, 1929; Pinder, 1978), differing by having a lower antennal ratio and a smaller inferior volsella. The presence of two long cercal setae will distinguish the adult females from all other *Chaetocladius* including *C. melaleucus* (see Goetghebuer, 1942). Also the immature stages do not equate with the adult male resemblance (see Pinder & Armitage, 1985, for detailed descriptions of the immature stages of *C. melaleucus).*

The distinctive scutal tubercle is not known to occur on other *Chaetocladius* pupa except on a single pupal exuviae mass reared from immersed wood (Québec, Gatineau Park, stream nr. Beech Grove, 5.VI.1985, P. S. Cranston & M. E. Dillon). This exuviae, otherwise similar to *C. ligni,* has an almost smooth thoracic horn and short (c. 3× as long as wide), thorn-like megasetae. An adult male obtained, at a later date, from the same rearing container cannot be distinguished from *C. ligni.* At present, it is not possible to determine if the pupal differences are due to variation because of the absence of larvae and positive association of the two life history stages. Therefore, eastern specimens, including an adult male from New Hampshire (White Mountain National Forest, Ammonoosuc River, 26.V.1981, D. R. Oliver & M. E. Roussel) are not included in the type series of *C. ligni.*

The larva differs from the generic diagnosis of Cranston et al. (1983) plus the addition by Pinder and Armitage (1985). SI is simple not serrated, plumose or branched, the premandible has 1 tooth apically, not 2, the basal sclerite is large, and the preanal segment is curved over the posterior segments. Furthermore, the mentum has only 4 lateral teeth although the lateral notch may be the remains of the notch between the 4th and 5th lateral teeth.

Orthocladius Wulp subgenus Symposiocladius Cranston stat. nov.

Orthocladius Wulp, 1874: 132. Type-species: *Tipula stercoraria* DeGeer, 1776: 388 sensu Wulp (misident.) (des. Coquillett, 1910: 581) = *Chironomus oblidens* Walker, 1856.

Symposiocladius CRANSTON, 1982: 419. Type-species: *Orthocladius lignicola* Kieffer in POTTHAST, 1915: 273 (orig. des.). Syn. nov.

Symposiocladius was erected for the xylophagous *Orthocladius lignicola* Kieffer, a species with a highly distinctive larva, but closely resembling *Orthocladius (Orthocladius)* in pupa and adult (CRANSTON, 1982). The major reason given for the erection of a new genus was the presence of the larval abdominal l_4 seta developed as a setal brush, which Cranston described as an unique inside parallelism/ underlying synapomorphy for the lineage *Synorthocladius* to *Cricotopus* (i. e., excluding *Orthocladius).* Two recent discoveries expose the fallacy of this reasoning: *Orthocladius annectens* Saether has previously unrecognized larval setal tufts and, since there is no doubt that *annectens* is truly an *Orthocladius,* setal tufts do occur in the *Orthocladius* lineage. Furthermore, *lignicola* larvae with only simple abdominal l_4 setae are now known (see below). The case well illustrates the erroneous nature of phylogenetic reasoning based upon ambiguous characters, particularly the use of non-unique derived character states ("underlying synapomorphies").

However, since the larva is highly distinctive and the pupa and female can be distinguished from other subgenera of *Orthocladius, Symposiocladius* can be retained as a subgenus of *Orthocladius* s. l. until the phylogeny is assessed and the ranking of other taxa presently given generic status, such as *Stackelbergina* Shilova and Zelentzov, is resolved.

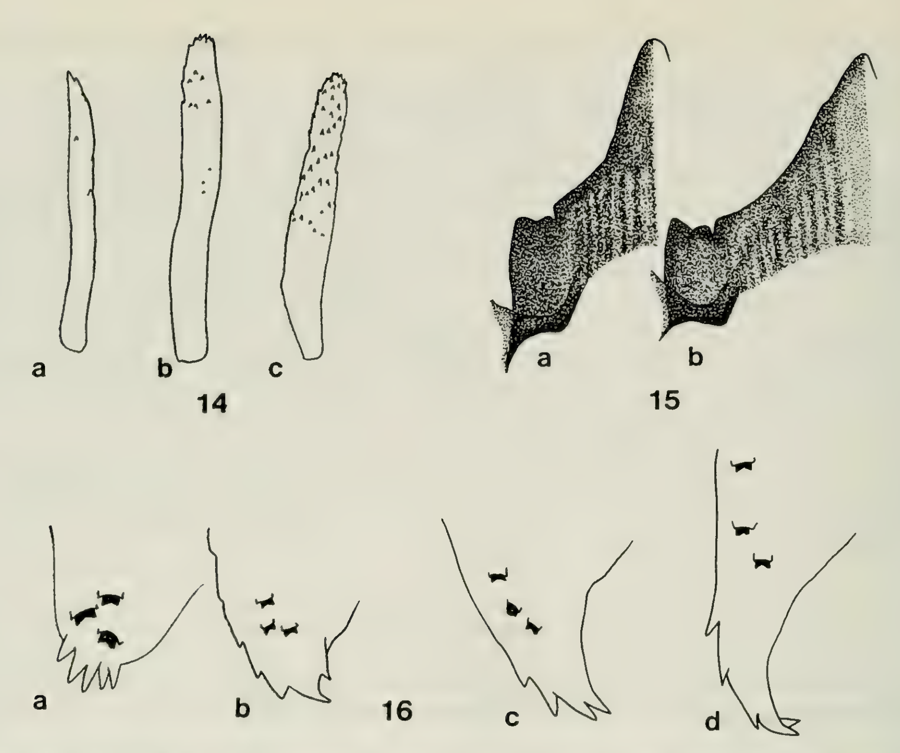
Orthocladius (Symposiocladius) lignicola Kieffer

Orthocladius lignicola Kieffer in POTTHAST, 1915: 273; CRANSTON, 1982: 421. Type-locality: West Germany, Sauerland, Haspersperre. Lectotype pupa examined CRANSTON, 1982: 421 (ZSBS).

CRANSTON (1982) described all stages of *O. lignicola* – "typical" *lignicola* in this discussion refers to this description. All specimens are closely associated as larvae with wood immersed in running water. Localities referred to in the discussion are cited in detail below.

In Berry Creek, *O. (Symposiocladius)* larvae (n = 100+) virtually always have a simple, or at most 2 branched abdominal l_4 seta and have more or less fused lateral mental teeth (Fig. 15 a) but otherwise resemble typical *lignicola,* with all measurements falling into the lower end of the range cited (CRANSTON, 1982: 426). This larval type ("A") is associated with pupae (type "A") lacking frontal setae, with a weakly spinose thoracic horn (Fig. 14 a) 200–280 μm long (n = 40), and with a blunt spinose apex to the anal lobe (Fig. 16 a). Adult males from Berry Creek fall towards the small end of the ranges cited by SOPONIS (1977: table ZZ, as *tryoni)* except for the terminal antennal flagellomere (450–550 μm long) and antennal ratio (0.98–1.18, n = 9) which fall at or below the cited range. Females cannot be distinguished from typical *lignicola* (CRANSTON, 1982: 421). Despite the apparent identity of the genitalia of both sexes, the low male antennal ratio, simple larval l_4 seta, absence of pupal frontal setae and differences in pupal anal lobe conventionally would indicate specific distinction. However, from Berry Creek we have seen a single *O. (Symposiocladius)* larva with fused lateral mental teeth, but with abdominal l_4 setal tufts with 6–8 branches about 80 μm long (typical *lignicola* have 20+ branches, up to 160 μm long) and one typical *lignicola* pupa with pharate adult (terminal flagellomere 620 μm long, antennal ratio 1.4). Furthermore a single prepupal larva of type "A" from Yukon contains a pupa with typical *lignicola* curved spinose apex to the anal lobe, but the frontal setae and thoracic horn cannot be seen.

In Mack Creek only typical *lignicola* larvae have been found (n = 25). Pupal exuviae derived from mass rearing from colonised immersed wood (not directly associated) all have a curved, spinose anal lobe apex typical of *lignicola,* a rather densely spinose cigar-shaped thoracic horn (Fig. 14 c), length 165–201 μm, but lack frontal setae (n = 17). This pupal type is associated with typical *lignicola* larvae associated with prepupae and a pupa from Starvation Creek. Mass rearings from immersed wood from Mack Creek give rise to males with a relatively long apical flagellomere (c. 600–650 μm) but rather



Figs. 14–16. *Orthocladius (Symposiocladius) lignicola* Kieffer. Pupa, – 14 thoracic horn (a – Berry Creek, b – Beech Grove, c – Mack Creck), – 16 apex of anal lobe (a – Berry Creek, b and c – Beech Grove, d – Mack Creek). Larva, – 15 mentum (a – Berry Creek, b – Beech Grove).

low antennal ratio (1.2–1.3). This Mack Creek pupal type also occurs in Flynn Creek, together with type "A" pupae. Both typical *lignicola* and type "A" larvae were present, but no associations are available.

Re-examination of most of the material studied by Cranston (1982) confirmed that none of these "aberrant" types mentioned above were present, unrecognized, and showed that frontal setae (omitted from the description) were invariably present in earlier examined Nearctic and Palaearctic specimens. However, the low antennal ratio (relative to the mean value) cited by Soponis (1977: table ZZ) suggests that some adults associated with the larval types above are included, since adults associated with typical *lignicola* larvae and pupae tend to have an antennal ratio of at least 1.5.

In order to resolve the status of the specimens discussed above, immersed wood, mostly *Alnus* sp., known to contain *O. (Symposiocladius)* larvae was collected in mid-June and again in mid-July from a stream in Gatineau Park near Beech Grove. This was kept in an oxygenated aquarium cooled to approximately 12°C and emergent adults, cast skins and pharate adults were collected at intervals over the ensuing four months. Individual rearings were not possible since *lignicola* larvae are easily damaged in handling and die very readily. However, some larval/pupal and pupal/adult associations were made through failed emergence at the aquarium water surface. All larvae examined (n = 29) are typical *lignicola,* with well developed setal tufts, although the lateral mental teeth division is somewhat variably developed (Fig. 15b). Most pupae (n = 38 of 40) have frontal setae, a moderately spinose thoracic horn 220–275 μm long (Fig. 14b) and an anal lobe intermediate (Figs. 16b–c) between that of type "A" and typical *lignicola* (Figs. 16a, 16d). One pupa, otherwise similar to this, has only 1 scar of a frontal seta on one side of the frons, with no trace on the other side. One pupa has no trace of frontal

setae, a weakly spinose thoracic horn 160 μm long and a blunt spinose apex to the anal lobe, closely resembling pupal type "A". The pharate adult within this pupa has an apical flagellomere length 415 μm and antennal ratio of 1.13. Adult males associated with the dominant pupal type in this mass rearing could not be distinguished from typical *lignicola,* having an apical flagellomere 540–640 μm long and antennal ratio of 1.4–1.6 (n = 10). Adult females cannot be distinguished from typical *lignicola.*

Clearly, from the evidence above, it is impossible to recognize separate species which can be confirmed from all life history stages. The adult males could be divided into those with an antennal ratio below 1.2 and a relatively short apical flagellomere (for example, below 550 μm) and those with a higher antennal ratio and longer apical flagellomere, but there is virtually continuous variation in these characters. There is remarkably little variation in both absolute size and wing length in all specimens examined, with the range less than 10 % each side of the mean, thus it is unlikely that the increased length of the apical flagellomere and antennal ratio is explained by allometry. Although the low antennal ratio male is apparently associated with the type "A" larva and pupa, this is not exclusively so. The highest values of antennal ratio and apical flagellomere length are found in association with typical *lignicola* larvae and pupae in Nearctic and Palaearctic populations. Intermediate values of antennal ratio and apical flagellomere length are found in Mack and Flynn Creek and Québec populations which have typical *lignicola* larvae but at least 3 different combinations of pupal characters. However, there is no detectable correlation between pupal characters of the anal lobe, frontal setae and thoracic horn and the complex tergal and sternal spine patterns, pedes spurii A and B and thoracic setation. Adult females, increasingly recognised as valuable in the detection of cryptic species, are relatively invariate and indicate a single species.

In each intensively sampled habitat more than one pupal type occurs, but this is not always correlated with the occurrence of more than a single type of larva or male. The variation evident in the Québec pupae, for example is not evident in larvae or adults. We conclude by suggesting that on present evidence *O. lignicola* is a single species and cannot yet be divided.

At present, it is not possible to explain the variation seen in *lignicola,* although several possibilities can be raised. There may be a clinal variation in the length of the apical antennal flagellomere and antennal ratio. The highest values for both are found in the easternmost populations examined in Québec and the lowest values in Oregon. Superimposed on this, there is some evidence that winter (Oregon) or spring (Québec) adults have a lower antennal ratio and shorter apical antennal flagellomere than adults emerging later. This must be analysed in more detail, with more individual associations of all life history stages and with control over the effect of rearing in laboratory cultures.

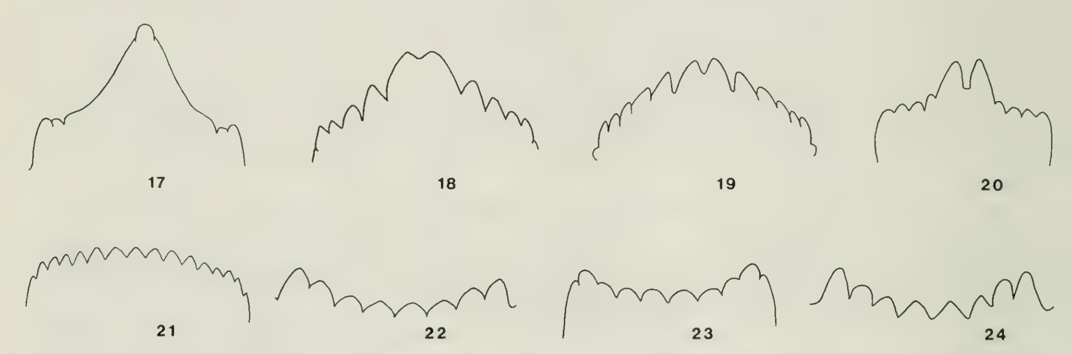
The apparently excessive variation in *O. lignicola,* in characters that are believed to be of specific importance in other taxa, might suggest a faulty species concept or inability to discriminate closely related species. However, recognition is growing that some taxa do show high variation in terms of traditional characters used in delimitation of chironomid species. For example, the hygropetric *Orthocladius (Eudactylocladius) fuscimanus* Kieffer and *O. (E.) dubitatus* Johannsen both show as much variation as does *O. lignicola.* In all cases the variation is demonstrated to be intraspecific through recognition of high variation present within a single population.

New material examined: CANADA, Yukon Territory: Alaska Highway, Watson Lake Campground, 60°07′ N, 128°48′ W, 23. V. 1982 (E. Fuller) (1 prepupal L.); Québec: Pontiac County, Gatineau Park, 8 km N. Beech Grove, 45°35′ N, 76°8′ W, 18. V. 1983 (D. R. Oliver & M. E. Roussel) (3 Pe.), 17. VI. 1985 (mass reared from immersed wood) (P. S. Cranston and M. E. Dillon) (10 ♂♂, 8 ♀♀, 1 ♂ and 1 ♀ with associated Pe., 1 P. with associated Le., 44 Pe., 29 L., slide mounted, many more in spirit); Missisquoi County, 1 m. N. Abercorn, (reared ex *Acer)* 19.–27. VIII. 1980 (A. Borkent) (3 ♂♂, 1 ♀ P. with associated Le., 9 Pe.,). U.S.A., Oregon: Benton County, Berry Creek, 14.–28. VII. 1982 (mass reared from immersed wood) (N. H. Anderson) (9 ♂♂, 1 ♂ with associated Pe., 10 ♀♀, 1 ♀ P. with associated Le., 40 Pe., 100+ L); Lincoln County, Flynn Creek, 30. VII.–28. XII. 1982 (mass reared from immersed wood) (N. H. Anderson) (2 ♂♂, 1 ♂P., 1 ♀P., 8 Pe., 20+ L.); Lane County, Mack Creek, 7. VII.–28. IX. 1982 (mass reared from immersed wood) (N. H. Anderson) (3 ♂♂, 17 Pe., 20+ L.); Hood River

County, w. of Hood River, Starvation Creek, 27. VI. 1981 (A. Borkent) (1 Le. with associated prepupa, 5 L.). Some Berry, Flynn and Mack Creek specimens in collection of N. H. Anderson (OSU), remainder in CNC.

Discussion

A major impediment to the elucidation of the rôle of Chironomidae in aquatic wood decomposition, even in the best studied north temperate regions of the world, has been taxonomic. For example, CRANSTON (1982) traced the first discovery of a distinctive larva (called *"acutilabis")* to KONSTANTINOV (1948), yet it was 30 years before its xylophagy was established, despite Thienemann's knowledge that the eventually associated pupa and adult belonged to a xylophage (hence the specific name *lignicola* given by Kieffer). Similarly, although the genus *Stenochironomus* Kieffer has been known to include wood-mining larvae since ZABLOTSKII (1939), it was not until BORKENT's (1984) monograph that its great taxonomic diversity and the wood-mining of its relatives was revealed.



Figs. 17–22. Larva, outline of anterior margin of mentum. – 17 *Orthocladius (Symposiocladius) lignicola* Kieffer, – 18 *Chaetocladius ligni* sp. nov., – 19 *Limnophyes* sp. ident., – 20 *Xylotopus par* (Coquillett), – 21 *Polypedilum (Polypedilum) fallax* (Johannsen), – 22 *Harrisius pallidus* Freeman, – 23 *Stenochironomus (Stenochironomus) hilaris* (Walker), – 24, *Xestochironomus subletti* Borkent.

There are several reasons for the relative paucity of taxonomic studies, including failure to include woody substrates in routine aquatic invertebrate surveillance, difficulties in sampling immersed wood and the fragile nature of many xylophagous larvae. However, there is no doubt that suitably located immersed wood of an appropriate age, especially *Alnus* spp., may have dense mixed populations of wood-mining Chironomidae, contributing substantially to the diversity and biomass of the aquatic biota. For example, KAUFMAN (1983) reported an annual standing biomass of 5000 mg/m^2 of *Xylotopus par* (Coquillett) and Anderson (in prep), a lower figure of 57 mg/m^2 from a mean of 618 *C. ligni* and *O. lignicola*/m^2. Sampling can pose difficulties and assessment of adult emergence from rearings from aquarium retained wood may avoid many problems. However this method, widely used by Anderson and his colleagues, only allows, at best, circumstantial larval/adult associations. Furthermore, wood held in the laboratory gives rise to adult emergence from both xylophages and insects using the wood surface as a substrate for other feeding methods. High pressure hosing of the wood after recovery from the aquatic habitat may remove many non-stenotopic invertebrates, but ambiguity remains. However, obligate wood feeders starve if removed from wood. Thus the optimum method to obtain associations of xylophagous larva, pupa and adult is to mass rear in natal wood, obtaining larval head capsules by recovery from mines that contain pupae whose identity can be established through pupal/adult associations either as pharate adults or through partial emergence.

Mass rearing, as discussed above, does not readily discriminate between obligate xylophages and other benthic insects associated in a less stenotopic manner with woody substrates. Discussions concerning xylophagy are handicapped by our still limited knowledge of the precise nature of associations with wood. A major criterion is the making of mines or galleys in wood, and/or the domination of the larval gut contents by wood. Even observations on gut contents may be ambiguous, since insects deriving epilignic nutrients (from superficial components on immersed wood) will ingest non-dietary wood fibres, particularly from extremely soft and decomposing woods. Analyses of xylophagous chironomid guts to establish the presence either of cellulases or a symbiont cellulose decomposer fauna, required to confirm stenoxylophagy, have been made only in *X. par* (Kaufman et al., 1986) and even this study failed to demonstrate cellulase activity of gut microflora. Therefore, our assessments of habit are of necessity somewhat circumstantial, but we present the following list and categories of xylophagous Chironomidae:

Taxa strongly suspected of being obligate xylophages, only found mining in immersed wood, and with guts consistently filled with wood fibres, include: Chironominae: *Stenochironomus (Stenochironomus), Harrisius* Freeman and *Xestochironomus* Sublette & Wirth species (Borkent, 1984); *Polypedilum (Polypedilum* Kieffer), including at least Nearctic *fallax* (Johannsen) (Johannsen, 1937, Roback, 1953); Orthocladiinae: *Chaetocladius ligni* sp. nov.; *Orthocladius (Symposiocladius) lignicola* Kieffer (Cranston, 1982); *Xylotopus par* (Coquillett) (Oliver, 1982; 1985).

Taxa which may be obligate xylophages but confirmation is lacking include: Chironominae: *Glyptotendipes (Phytotendipes) testaceus* Townes (reared from a water soaked log in Arkansas, Derreoux Creek, W. Pine Bluff, route 270, 12. III. 1972, H. Teskey, C. N. C.); other perhaps misidentified *Glyptotendipes,* including *gripekoveni* (Kieffer) from the Netherlands (Gripekoven, 1914) *glaucus* (Meigen) (= *pallens* [Meigen]) from England (Burtt, 1940) and *"dendrophila"* from the Soviet Union (Zvereva, 1950); Orthocladiinae: *Limnophyes* sp. indet. unreared from Oregon streams, perhaps associated with *L. pilicistulus* Saether adults emerged from laboratory mass rearings of immersed wood (N. H. Anderson).

Taxa with distinct associations with immersed wood, but either unsubstantiated as miners and/or having a wood diet: Chironominae: *Stelechomyia perpulchra* (Mitchell) from S. E. USA (Reiss, 1982); *Polypedilum (Polypedilum)* including palaearctic *pedestre* (Meigen); Orthocladiinae: *Brillia*, particularly *flavifrons* group species in Palearctic and Nearctic regions; Diamesinae: *Pagastia* larval type A of Oliver and Roussel, 1982 (Nearctic observations by Cranston).

Many other Chironomidae have been recorded from immersed woody substrates but the nature of the wood association is unclear. For example, many of the genera listed by Dudley and Anderson (1982) appear to be no more than casual visitors using the wood as either resting sites or for feeding. Our categories above reflect our knowledge of mining: we have too little evidence to consider the rôle of these epiphytic taxa in wood degradation.

The wood mining taxa listed above show no close phylogenetic relationships to one another, with the exception of internal relationships within the *Stenochironomus* complex. Thus several unrelated (or at least very distantly related) taxa have come to occupy aquatic woody microhabitats. Three subfamilies are represented: the Diamesinae, Orthocladiinae and Chironominae. Only within the *Stenochironomus* complex (Borkent, 1984) is there evidence of species formation in a monophyletic grouping probably following ancestral adoption of the wood mining habit (Borkent, 1984). In other taxa here considered the mining habit has been independently acquired. Phyletically close relatives of mining taxa tend to be rheophilic and, where known, appear to be Aufwuchs grazers. Taxa in which mining is probable, but not established with certainty, include some species that otherwise burrow in immersed leaves *(Brillia, Stelechomyia, Polypedilum).* Since there are examples of presumed wood mining in which the immersed wood is so soft that it is friable by hand, there may be little distinction between grazing on immersed leaf surfaces and on soft wood. In either case, the source of nutrition may be other than wood derived cellulose since the chironomid gut contents frequently contain algae and fungi in addition to wood fibre.

Given that wood mining Chironomidae are not related, are there morphological features (convergences) associated with the larval habit? One of the few characteristics that unite many miners, irrespective of subfamily, is the very flimsy body cuticle, which cannot support the flaccid larva outside the mine. This is particularly striking in *O. (Symposiocladius)* and *Stenochironomus*, less so in *Xylotopus*, and explains the fragility of the larva leading to larval death if extracted live from wood for rearing. Within the Orthocladiinae, structures of the wood miners' head capsule show some convergence, with the mental teeth characteristically elongate (Figs. 17–20) and heavily sclerotised relative to non-mining congeners or close relatives. Other similarities include the broadening and shortening of the mandible and the narrowing of the anterior labrum, with a folding of the anterior part beneath the frontoclypeus in such a way that it cannot be flattened readily for microscope examination. In *C. ligni*, *O. (S.) lignicola* and the undescribed mining *Limnophyes* species referred to above, the S I seta is simple compared to the condition in congeners, but there is little evidence of any further reduction in head capsule appendages such as the antenna, maxilla, and labral chaetae, or in the abdominal appendages (prolegs, procerci, and anal tubules). In contrast, the obligate wood miner *X. par* lacks these orthocladiine character state changes associated with the mining habit, with the exception of the lateral compression and strong folding of the labrum beneath the frontoclypeal apotome.

In contrast to the Orthocladiinae, mining Chironominae do not have an anteriorly projecting median part of the mentum (Figs. 21–24). *Stenochironomus* do indeed have a modified mentum, but this mentum is transverse with very reduced teeth. The very great reduction of the striae of the ventromental plates is also characteristic, is perhaps associated with a loss of silk making and is part of a transformation series that includes non-wood mining species. *Polypedilum* miners appear little different from non-mining congeners and neither does *Glyptotendipes testaceus* differ greatly from its non-(wood) mining relatives. The diamesine *Pagastia* (larval type A) has a most curiously modified mentum with the teeth obscured by lying ventral (and posterior) to a continuous ventromental plate (Oliver & Roussel, 1982, fig. 4). It is impossible to speculate on how this unusual structure may be related to feeding, let alone to wood mining.

Although much work remains to be done, some ecological generalisations can be made concerning wood-mining Chironomidae. Firstly, mining Chironomidae may be locally abundant but by no means all immersed wood contains larvae. In lotic systems, suitable wood must be anchored in the current, but not such that it becomes covered in sediment. Mining Orthocladiinae are not found in poorly oxygenated running waters, although at least in Britain, *O. (S.) lignicola* larvae can tolerate high organic loadings in fast current. In contrast to the situation in lotic systems, Orthocladiinae are much less common in lentic habitats, where Chironominae (notably *Stenochironomus*) dominate the wood-mining chironomids. Once again, immersed wood must be free from sediments for successful colonisation (A. Borkent, pers. comm.).

The quality and texture of wood is important in relation to the frequently observed differences in colonisation of different wood species. For example, it is a common observation that alder (*Alnus* spp.) in the Holarctic, and maple *(Acer)* in the Nearctic, are strongly preferred substrates for many miners. Unquantified observations in Britain show that in a stream known to support *O. lignicola*, freshly placed *Alnus* branches were colonised after five winter months and larvae were not found in any other immersed wood, ranging from oak *(Quercus)* to pine *(Pinus)*. *O. lignicola* is most abundant in wood so recently immersed that a knife is required to excise larvae and is not found in soft wood. In contrast, *X. par* and *Pagastia* larval species A appear to be most abundant in wood friable enough to crumble by hand. However, faunal succession in relation to temporal changes in wood quality are little known at present. The rôle of chironomids in wood breakdown and their dietary use of apparently refractory wood and/or associated microbial flora are poorly understood and elucidation through further study is required.

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Chironomidae of South India. I. Generic composition, biogeographical relationships and descriptions of two unusual pupal exuviae

(Diptera, Chironomidae)

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Abstract

Collections of pupal exuviae were made from 25 sites (lotic, lentic and marine) in the states of Tamil Nadu and Kerala, South India. Species-level taxa belonging to 55 named genera (35 new to India) were encountered – increasing the number of named genera known to occur in India from 38 to 73. An additional 20 possibly "new" genera were also discovered. Descriptions for two of these "new" genera, which are not referable to any known subfamily, are given. Almost all of the named genera collected in S. India are known to occur widely in the Holarctic region, and many are subcosmopolitan. The 20 "new" genera may represent an endemic component in S. India. However, there is some evidence that at least a few of these "new" genera may occur elsewhere in the Oriental region.

Introduction

Sublette & Sublette (1973) list 56 genera of Chironomidae from the Oriental Region. Due to synonymy only 53 of the generic names they give are still considered to be valid (Ashe, 1983). Of these, only 21 had been recorded from India (Table 1). Since 1973 a number of investigators have added to our knowledge of the generic composition of the chironomid fauna of India (Bhattacharya et al., 1985a, 1985b; Chaudhuri & Debnath, 1985; Chaudhuri & Ghosh, 1981, 1982a, 1982b, 1986; Chaudhuri et al., 1984; Chaudhuri et al., 1979; Ghosh & Chaudhuri, 1983; Hirvenoja, 1985; Singh & Kulshresta, 1975; Sinharay & Chaudhuri, 1978, 1984; Sinharay et al., 1978). As a result of these efforts, the number of genera known to occur in India has risen to 38 (Table 1).

Nearly all of the distribution records given for the Chironomidae of India in Sublette & Sublette (1973) and all but one *(Chaetocladius)* of the more recent additions to the Indian fauna have come from Indian states bordering on the Himalayas. In this paper we are presenting the results (at the generic level) of a series of collections of pupal exuviae made in the southern Indian states of Tamil Nadu and Kerala. Broad biogeographical affinities of this fauna are discussed and two unusual pupal exuviae, that cannot be placed in any subfamily, are described. Forthcoming papers will treat the subfamilies Tanypodinae, orthocladiinae and Chironominae.

Material and Methods

All of the specimens utilized in this study were collected using the surface drift pupal exuviae method (Brundin, 1966; Coffman, 1973; Pinder, 1986; Wilson & Bright, 1973). Collections were made with fine mesh drift nets and soil sieves (125 microns) and field preserved in 70 % EtOH. Collections were sorted at 12× and series of each species from each sample were slide mounted with Euparal for identification and study. Abbreviations utilized in the descriptions are from Saether (1980).

Table 1. Chironomidae genera reported from India in SUBLETTE & SUBLETTE (1973) and from recent literature sources.

SUBLETTE & SUBLETTE (1973)	Recent Literature
TANYPODINAE	
Ablabesmyia	*Paramerina* (CHAUDHURI & DEBNATH, 1985)
Clinotanypus	
Procladius	
Tanypus	
DIAMESINAE	
Diamesa	
Sympotthastia	
ORTHOCLADIINAE	
Brillia	*Bryophaenocladius* (GHOSH & CHAUDHURI, 1983)
Cricotopus	*Chaetocladius* (CHAUDHURI & GHOSH, 1982 a)
Heterotrissocladius	*Eukiefferiella* SHINHARAY et al., 1978)
Parametriocnemus	*Limnophyes* (CHAUDHURI et al., 1979)
	Metriocnemus (SHINHARAY & CHAUDHURI, 1978)
	Nasuticladius (SINHARAY & CHAUDHURI, 1984)
	Orthocladius (CHAUDHURI & GHOSH, 1982 b)
	Paracladius (HIRVENOJA, 1985)
	Paratrichocladius (HIRVENOJA, 1985)
	Thienemannia (BHATTACHARYA et al., 1985 a)
CHIRONOMINAE	
CHIRONOMINI	
Chironomus	*Beckidia* (BHATTACHARYA et al., 1985 b)
Cryptochironomus	*Cladopelma* (BHATTACHARYA et al., 1985 b)
Dicrotendipes	*Gillotia* (BHATTACHARYA et al., 1985 b)
Glyptotendipes	*Kiefferulus* (CHAUDHURI & GHOSH, 1986)
Harnischia	
Lauterborniella	
Nilodorum	
Paratendipes	
Polypedilum	
Stenochironomus	
TANYTARSINI	
Micropsectra	*Paratanytarsus* (CHAUDHURI et al., 1984)
	Tanytarsus (SINGH & KULSHRESTA, 1975)

Taxonomic placement

It has been established that pupal exuviae of most chironomids are easily placed at the generic level. There are, however, a few striking exceptions; for example, *Baetotendipes*, *Chironomus* and *Einfeldia* species group C (PINDER and REISS, 1986). For this reason, as well as others, the list of chironomid genera given here should be considered to represent a minimum number of genera actually present. A further complication in taxonomic placement was encountered frequently in this material. Many of the species placed in named genera do not conform exactly to all aspects of the pupal diagnoses of genera given in WIEDERHOLM (1986). When the differences were only slight, the species were placed in the

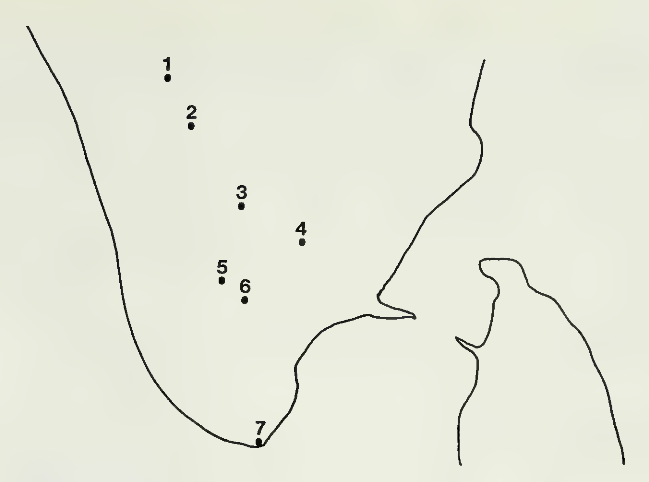


Fig. 1. Map of extreme southern India — numbers indicate areas in which collections were made: 1–2, Ootacamund-Coimbatore Road; 3–4, Kodaikanal-Madurai Road; 5, Periyar; 6, Rajapalaiyam; 7, Cape Cormorin.

appropriate named genera. However, when the differences were considered to have a greater probability of taxonomic significance, the species were either placed in a named genus, with the name given in quotation marks in the list, or the species were considered to be different enough to warrant placement in separate, numbered genera.

Collection sites

Most of the 25 collection sites were first to fourth order streams and were visited only once. however, a few lentic systems (ponds and reservoirs) and one marine locality were also sampled. Two areas were collected relatively extensively: the Palni Hills in the vicinity of Kodaikanal and the Nilgiri Hills in the vicinity of Ootacamund. Additional collections were made from a stream in the vicinity of Rajapalaiyam, Tamil Nadu, a stream near Periyar Lake, Kerala and tidal rock pools at Cape Comorin (Fig. 1).

Results and Discussion

Among the approximately 150 species-level taxa represented in these collections, 55 named genera (including Chironomini Genus D and Genus E of Pinder & Reiss [1986]) were identified (Table 2). All but one of these *(Sublettea)* is known from the Palaearctic, and all but two of the remaining genera *(Paratrissocladius* and *Virgatanytarsus)* are Holarctic in distribution. In addition to the 55 named genera represented in these collections, another 20 "new" genera were recognized. These categories were established for species-level taxa that could not be placed in any of the genera for which diagnoses are given in Wiederholm (1986) or other literature, even when the generic limits were reasonably expanded to allow for some differences (Table 2).

Thirty-five of the named genera represented in the collections from South India are recorded here for the first time from India-bringing the total number of genera with known distributions in India to 73 (Table 2).

Roback & Coffman (in press) found that the fauna of high altitude regions of Nepal, with only four possible endemic genera (all Tanytarsini and based on larvae), was overwhelmingly Holarctic in distribution. The results of other workers in the northern regions of the Indian subcontinent have included

Table 2. Genera of Chironomidae collected as pupal exuviae from South India. *indicates new to India.

TANYPODINAE
Ablabesmyia
*Conchapelopia**
*Hayesomyia**
*Larsia**
*Nilotanypus**
Paramerina
Procladius
Tanypus
*Zavrelimyia**
Pentaneurini Genera 1–5

ORTHOCLADIINAE
Bryophaenocladius
*Cardiocladius**
*Clunio**
*Corynoneura**
Cricotopus
Eukiefferiella
*Heleniella**
*Krenosmittia**
Limnophyes
*Nanocladius**
*Paracricotopus**
Parakiefferiella
*Parametriocnemus**
*Paratrissocladius**
*Rheocricotopus**
*Rheosmittia**
*Thienemanniella**
Orthocladiinae Genera 1–4

CHIRONOMINAE

CHIRONOMINI
Chironomus
Cladopelma
Cryptochironomus
*Cryptotendipes**
Dicrotendipes

CHIRONOMINI (continued)
Glyptotendipes
Harnischia
*Microtendipes**
Nilodorum
*Parachironomus**
*Paracladopelma**
*Paralauterborniella**
"Paratendipes"
*Phaenopsectra**
Polypedilum
*Robackia**
*Saetheria**
Stenochironomus
*"Stictochironomus"**
Chironomini Genus D*
(Pinder & Reiss, 1986)
Chironomini Genus E*
(Pinder & Reiss, 1986)
Chironomini Genera 1–6

TANYTARSINI
*Cladotanytarsus**
*Rheotanytarsus**
*Stempellinella**
*Sublettea**
Tanytarsus
*"Virgatanytarsus"**
*Zavrelia**
Tanytarsini Genera 1–3

PSEUDOCHIRONOMINI
*Pseudochironomus**

UNKNOWN CHIRONOMIDAE
Taxon 1
Taxon 2

only two endemic genera (*Asclerina*, Reiss [1968] and *Neopodonomus*, Chaudhuri & Ghosh (1981). *Neopodonomus* has, however, been shown to be a synonym of *Boreoheptagyia* (Roback & Coffman, in press). These results are, perhaps, not surprising since the areas that have been most extensively collected (montane regions) are ecologically more closely related to the Palaearctic than they are to the Oriental Region. The fauna of South India, as revealed by these collections, is clearly dominated by genera that have widespread distributions, but there is also a major component of apparently "endemic" genera. It is not clear whether these genera are limited to South India (perhaps including Sri Lanka) or are more widespread in the Oriental Region. Unfortunately, no comprehensive study of the chironomid fauna of any other part of the Oriental Region has been carried out. The limited data that do exist would seem to indicate that at least some part of this group of "endemic" genera may occur in other parts of the Oriental Region. Thienemann, Johannsen, Zavrel and Lenz found a chironomid

fauna on the Greater Sunda Islands that may be similar to that of South India. The S. Indian species that is here placed in "*Stictochironomus*" bears some resemblance to *Stictotendipes* Lenz (1937) and the *Rheotanytarsus anomalus* group of Zavrel (1934) reported from Sumatra also occurs in the South Indian material. There are other known connections of the South Indian fauna with other parts of the Oriental Region. The species of *Sublettea* from South India is very similar (perhaps identical) to that found by Fittkau in SW China and reported by Pinder & Reiss (1986). Chironomidae Genus 2 (described below), or something very similar, has recently been found in China and in collections from Burma (E. J. Fittkau, personal communication).

Descriptions of pupae of two unusual taxa

Taxon 1

Pupa (Figs. 2–8):

Size demonstrating strong sexual dimorphism, total length of females 7.0 mm – 8.3 mm, $\bar{x}$ = 7.6 mm, n = 4; total length of males 5.3 mm – 6.5 mm, $\bar{x}$ = 5.4 mm, n = 6.

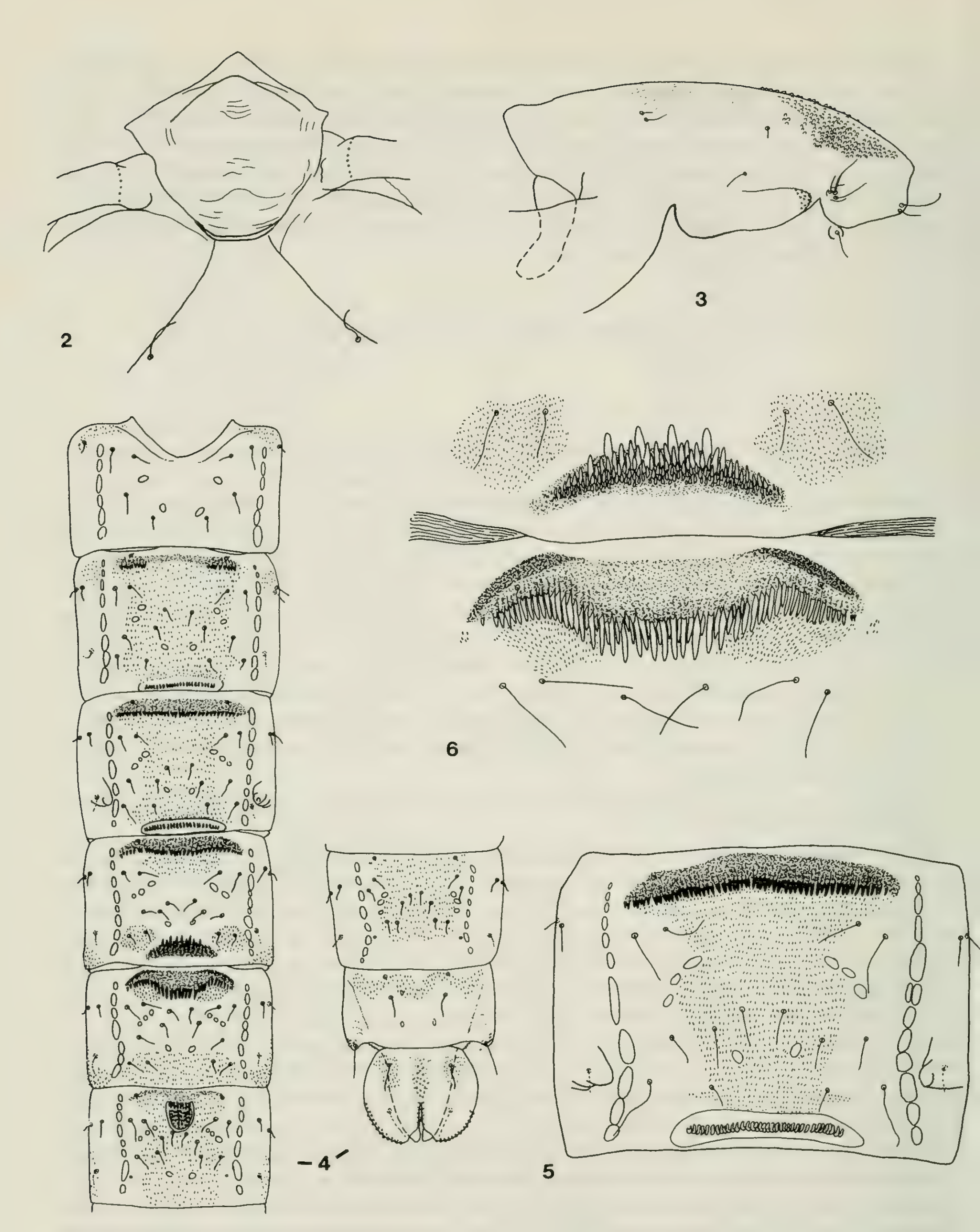
Cephalothorax: antepronotum, ventral structures of thorax, cephalic region and leg sheaths yellow; dorsal parts of thorax and wing sheaths yellow-brown; Cephalic area (Fig. 2): frontal apotome strongly sclerotized; frontal setae absent; frontal apotome without tubercles or warts; ocular field with one postorbital seta; Thorax (Fig. 3): antero-dorsal region of mesonotum with a field of very strong spine-like processes; fields of rugulosity dorsal of the dorsocentral setae, on the prealar lobe and on a lobe-like process posterior to the precorneal setae – the latter somewhat stronger than the other two fields; all leg sheaths recurved under wing sheaths; wing sheaths without pearl rows or terminal protuberance; thoracic horn absent; Chaetotaxy of thorax: two narrowly separated MAps; one LAps located on a low protuberance; four Dc setae, Dc2 (apparently) located much ventral of Dc1, Dc3 and Dc4 forming a posterior pair; three Pc setae of variable lengths, but Pc1 is usually shorter than the other two; no Pa or Mn setae present.

Abdominal segments I–VIII (Figs. 4–8): mostly yellow-brown, but armature and adjacent areas reddish-brown to black.

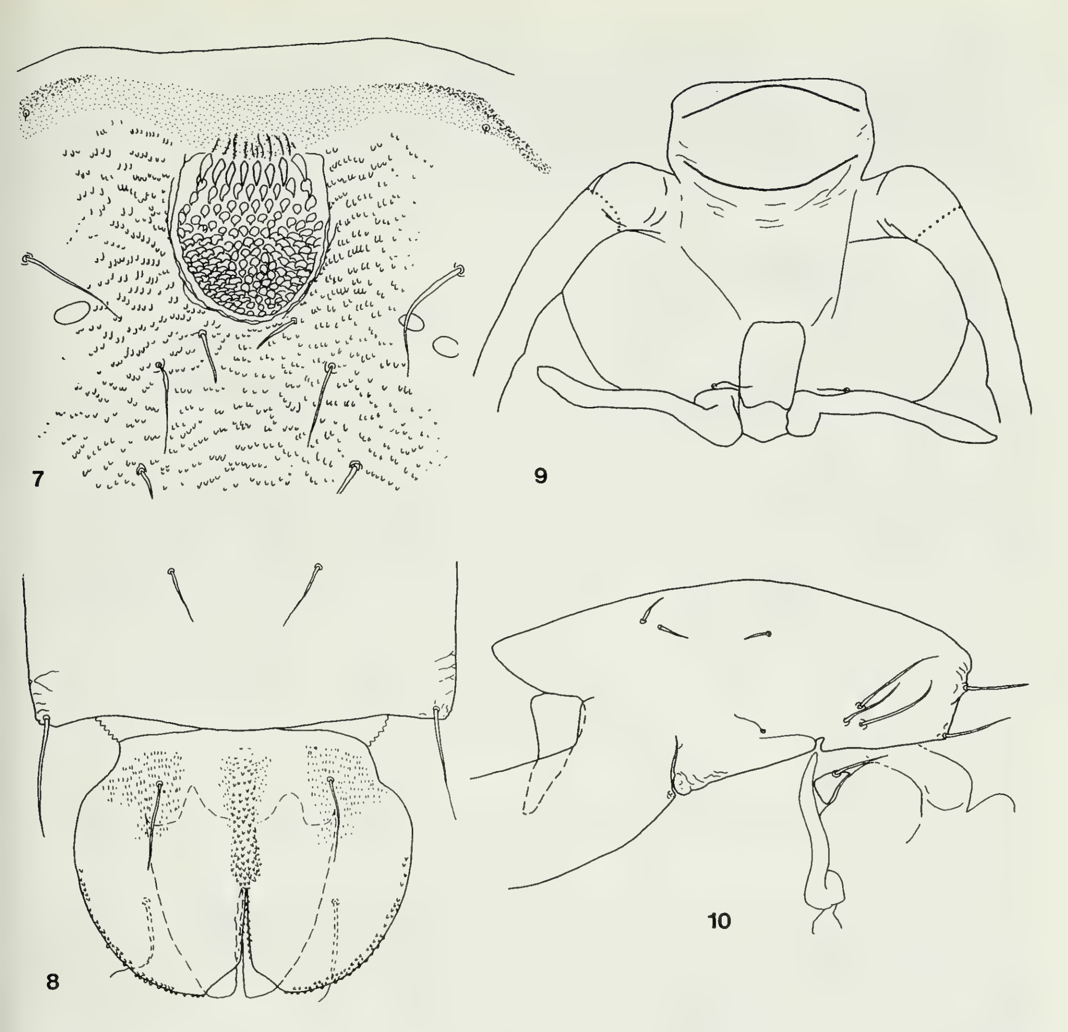
Shagreenation – tergites: tergite I without, tergites II and III with extensive fields of dense fine shagreen, slightly larger toward the posterior margins (Figs. 4–5), tergite IV with a narrow transverse anterior band and posterolateral areas of dense fine shagreen (Figs. 4 and 6), tergite V with two narrowly separated anterior groups and a transverse posterior band of fine dense shagreen (Figs. 4 and 6), tergite VI with most of the central area covered by fine, but less dense, shagreen, expanded laterally along the posterior margin (Figs. 4 and 7), tergite VII with central area covered with weak shagreen (Fig. 4), tergite VIII with a weak transverse anterior band or without shagreen (Figs. 4 and 8).
pleurites: pleurite I without, pleurites II and III with small anterior areas of fine shagreen, usually much weaker on III (Figs. 4–5), pleurites IV and V with extremely fine shagreen on posterior halves (Fig. 4), pleurites VI–VIII with extremely fine shagreen over much of surface, sometimes absent on VII and much of VIII.

Sternites: sternites I–VI with at most very fine and very sparse shagreen spinules, sternite VII with a weak anteromedian group of shagreen spinules, sternite VIII without shagreen.

Armature and other structures of abdomen: rows of approximately 50–60 Hl on posterior margins of tergites II and III (Figs. 4–5); tergites III (II)–IV with transverse anterior rows of sharp dark posteriorly directed spines (Figs. 4–5), tergite IV with a posteromedian transverse group of sharp, dark, anteriorly directed spines of varying lengths (Figs. 4 and 6); tergite V with a sinuous row of large, dark, posteriorly directed spines (Figs. 4–6); tergite VI with a dense, anteromedian, semicircular patch of spines (Figs. 4 and 7); tergites VII and VIII without armature; PSB absent on II, but a PSB-like structure present on segment III (Figs. 4–5); PSA absent on all segments.



Figs. 2–6. Taxon 1, pupa, – 2. cephalic region, – 3. thorax, lateral, – 4. abdomen, dorsal, – 5. segment 3, dorsal, – 6. posterior armature of tergite 4 and anterior armature of tergite 5.



Figs. 7–10. Taxon 1, pupa. – 7. Anteromedian armature of tergite 6, – 8. posterior margin of segment 8 and anal lobes, dorsal; Taxon 2, pupa. – 9. cephalic area, – 10. thorax and adjacent structures of cephalic region, lateral.

Chaetotaxy – tergites (Figs. 4–5 and 8): tergite I with 4 D setae; tergites II–V with 7 D setae; tergites VI and VII apparently with 6 D setae; tergite VIII with 1 D seta.

Pleurites: pleurite I with 1 L seta; pleurites II–VII with 3 L setae; pleurite VIII with one relatively large posterior L seta (Figs. 4–5 and 8).

Sternites: sternite I with V setae apparently absent; sternites II–VII with 4 V setae; sternite VIII with 2 V setae.

Anal lobes and segment IX (Figs. 4 and 8): tergite IX with lateral and median fields of shagreen; AL without marginal fringe of setae, but with several rows of small spine-like protuberances; each AL with a dorsal and ventral seta on the disc; inner margins of AL with small groups of weak spinules; genital sheaths of male extend to tip of AL.

Specimens examined:

Kodaikanal area, Palni Hills, Tamil Nadu, South India – small stream along Madurai – Kodaikanal Road, at milepost 36, 1 female pupal exuviae, 18 Mar. 1978; 3rd order stream along Madurai – Kodaikanal Road, about

4 km east of Kodaikanal, Tiger Forest stream, 2 female pupal exuviae, 20 Mar. 1978; 2nd order stream along Madurai – Kodaikanal Road, between mileposts 17/5 and 17/6, 1 male and 1 female pupal exuviae, 18 Mar. 1978; Ootacamund area, Nilgiri Hills, Tamil Nadu, South India – Vellappalam stream (2nd or 3rd order) along Coimbatore – Ootacamund Road, 1 male pupal exuviae (fragment), 5 May 1979; 2nd order stream along Coimbatore – Ootacamund Road, 3 male pupal exuviae, 8 May 1979; Kallar River (4th order stream) at base of Nilgiri Hills along Coimbatore – Ootacamund Road, 2 male pupal exuviae, 8 May 1979.

Taxon 2

Pupa (Figs. 9–15):

Moderate sexual dimorphism in size, total length of females 3.0 mm – 3.5 mm, $\bar{x}$ = 3.2 mm, n = 6: total length of males 2.5 mm – 3.25 mm, $\bar{x}$ = 2.9 mm, n = 12.

Cephalothorax: All thoracic structures yellow to yellow-brown; Cephalic area (Fig. 9); frontal apotome strongly sclerotized; frontal setae absent; frontal apotome without tubercles or warts; ocular field with one postorbital seta; Thorax (Fig. 10): dorsal surface of thorax not rugulose, but with very weak sculpturing; all leg sheaths recurved under wing sheaths; wing sheaths without pearl rows or terminal protuberance, but with an angular process on the inner margin near the base, adjacent to and fitting closely against the prealar lobe; thoracic horn absent; Chaetotaxy of thorax: two widely separated MAps; one LAps located on a low protuberance; four Dc setae, Dc2 or Dc1 located more ventrally than others, Dc3 and Dc4 forming a posterior pair; three relatively strong Pc setae of approximately equal size; no Pa or Mn setae present.

Abdominal segments I–VIII (Figs. 11–15): tergites light reddish-brown, armature of tergites dark reddish-brown; tergites II–VII with lateral, longitudinal dark brown lines; pleurites and sternites with little or no pigmentation.

Shagreenation – tergites: tergites II–VIII with lateral and/or anterior groups of very weak shagreen spinules (Figs. 11–15).

Pleurites: all pleurites without shagreen.

Sternites: sternites II–VIII with lateral, moderately dense groups of very fine shagreen spinules in irregular arching rows.

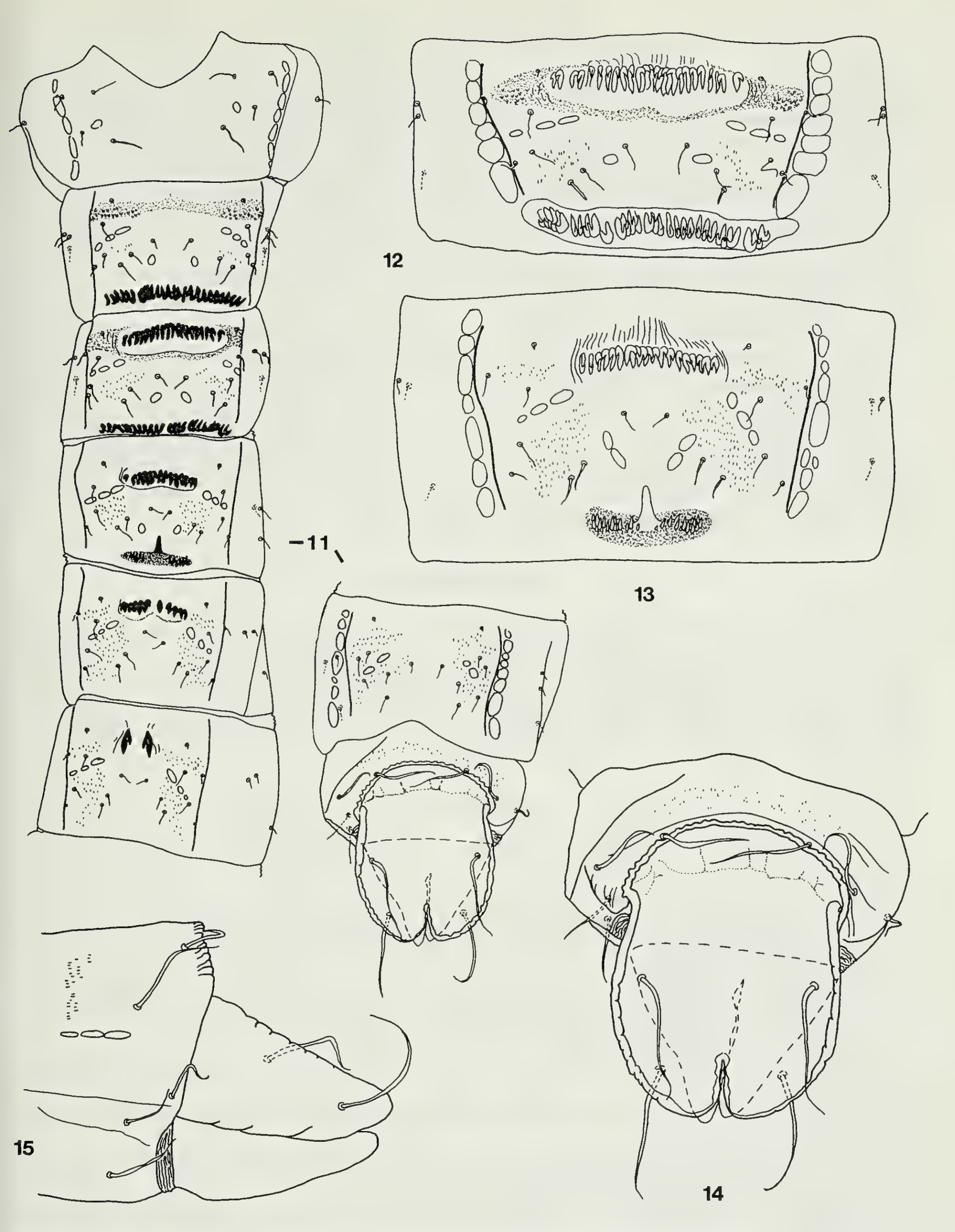
Armature and other structures of abdomen: posterior margins of tergites II and III with rows of about 25–30 strong Hl (Figs. 11–12); tergites III–V with anterior rows of strong Hl, 25–30 on tergite III, about 18 on tergite IV and about 12 on tergite V (Figs. 11–13); tergite IV with a posterior median group of anteriorly directed spines, the median spine in this group much larger than the others (Figs. 11 and 13); tergite VI with a pair of very large anteromedian Hl (Fig. 11); tergites VII and VIII without armature; PSB and PSA absent on all segments.

Chaetotaxy – tergites (Figs. 11–13): tergite I with 4 D setae; tergites II–VII with 7 D setae; tergite VIII with 2 D setae.
pleurites: pleurite I with 1 L seta; pleurites II–VII with 3 L setae; tergite VIII with 1–2 L seta.
sternites: sternite I without V setae; sternites II–VII with 4 V setae; sternite VIII with 1–2 V setae.

Anal lobes and segment IX (Figs. 11, 14 and 15): tergite IX without shagreen; AL without marginal fringe, but margin weakly crenulate; each AL with a dorsal and ventral seta on the disc; AL and segment IX forming a Telmatogetoninae-like concave, oval plate; the posterior margin of tergite VIII heavily sclerotized and crenulate, forming an arching ridge above the AL.

Specimens examined:

Ootacamund area, Nilgiri Hills, Tamil Nadu, South India – Kallar River (4th order), at base of Nilgiri Hills along Coimbatore – Ootacamund Road, 16 male and 10 female pupal exuviae, 8 May 1979.



Figs. 11–15. Taxon 2, pupa. – 11. abdomen, dorsal, – 12. segment 3, dorsal, – 13. segment 4, dorsal, – 14. segment 8 and anal lobes, dorsal, – 15. posterior margin of segment 8 and anal lobes, lateral.

Comments on taxa 1 and 2

Although the pupal exuviae of these unusual taxa differ from each other in size and many structural features, they have a number of basic similarities that, most probably, indicate a close relationship. Among these features are: 1). the absence of a TH; 2). the absence of FS; 3). the ventral position of one of the anterior Dc setae; 4). the unusual position of the LAps on a low protuberance; 5). the absence of LS on all abdominal segments; 6). the presence of only one L seta on segment VIII; 7). the presence of seven D setae on most tergites; 8). the absence of an AL fringe; 9). the presence of dorsal and ventral setae on the disc of the AL; and 10). the presence of unusual armature on the abdominal tergites.

Each of these taxa undoubtedly represents a new genus and, since the combination of characters that they possess is not consistent with any described subfamily, they most likely represent a new higher taxon as well, perhaps a new subfamily. The number and distribution of the thoracic setae of these taxa would seem to indicate a relationship with Orthocladiinae. However, the abdomen of Taxon 1 shows a number of relationships with *Pseudochironomus,* e. g., the shape of the AL and the presence of a nearly circular patch of spines on tergite VI. Some species of *Pseudochironomus* also have no fringe on the AL. The abdomen of Taxon 2 does not, however, show this possible relationship. Instead, the unusual arrangement of segment VIII and IX, with the AL, appears to represent a remarkable convergence with Telmatogetoninae. Clarification of the taxonomic position and phylogenetic relationships of these taxa must await discovery of the larvae and/or adults.

Acknowledgements

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A survey of the zinc-polluted River Nent (Cumbria) and the East and West Allen (Northumberland), England, using chironomid pupal exuviae

By R. S. Wilson

Abstract

Collections of chironomid pupal exuviae from zinc-enriched sites on the Rivers Nent, and East and West Allen in the English Pennines, showed consistently lower diversities than those from low-zinc sites. The dominant species found at zinc-enriched sites differ between the Nent and the Allens, being *Krenosmittia camptophleps* in the Nent, and *Eukiefferiella clypeata* and *Tvetenia calvescens* in the West Allen. The low-zinc sites may contain chironomid communities close to those which would live in normal unpolluted rivers of similar types to those investigated. These communities will vary as conditions change between different sites or rivers, but will form the basic set of species from which a zinc-tolerant sub-set will be selected in each case.

Introduction

The area of the North Pennine orefield in Britain, is notable for the extensive mining operations that were carried out principally during the eighteenth century (Dunham, 1949). Currently there is very little mining activity in the area, but previous workings and accumulations of mine spoil have left a legacy of acid and heavy metal enriched streams. The Rivers Nent and the East and West Allen, rise in the high moors near Alston, at the intersection of the three counties, Cumbria, Durham and Northumberland. This paper reports an investigation carried out in 1983, into the chironomid fauna of the zinc-enriched Nent and the Allens, using collections of chironomid pupal exuviae. It was hoped to gain some understanding of the distribution of the chironomid fauna in relation to the stream conditions, and in particular to the concentration of zinc in the water.

The rivers are affected by acid mine drainage from old mine workings, and are particularly rich in zinc. Certain locations also receive organic effluents of domestic and agricultural origin. Armitage (1980), studied the macroinvertebrates of an extensive series of sites on the Nent and its tributaries, and has related their distribution and abundance to broad categories of zinc concentrations. He also gives figures for certain chemical measurements related to organic and metal concentrations in the water. Abel & Green (1981) have reported on the ecology and distribution of macroinvertebrates on the Allens in relation to the zinc concentrations, which are significantly higher in the West, as opposed to the East, Allen.

In the Nent, Armitage (1980) showed that there was a significant negative correlation between the zinc level and the number of taxa per site, although the situation was complicated by localised inflows of calcium-rich water. Summer growths of *Stigeoclonium tenue* may also have affected the faunal distribution. Abel & Green (1981) showed that the fauna in the zinc-enriched West Allen was quantitatively and qualitatively restricted as compared to that in the East Allen, and suggest that this is directly due to the toxic effects of the zinc. They also showed a significant negative correlation between numbers of species of macroinvertebrate and the concentration of zinc in the water.

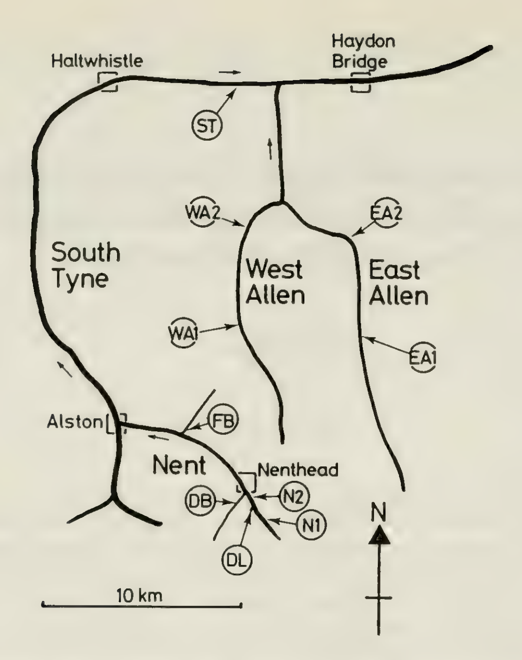


Fig. 1: Diagrammatic sketch-map of the section of the River South Tyne and its tributaries the River Nent and the East and West Allen. Sampling sites are shown in circles.

Other work on the effects of heavy metals on river invertebrates includes the classical studies on the Rivers Ystwyth and Rheidol in North Wales (see eg. CARPENTER, 1924; JONES, 1940), and on the Willow Brook by SOLBÉ (1977), while a general discussion may be found in WHITTON (1975). Little of the data refers in detail to the Chironomidae, however, and the work reported in this paper is an attempt to remedy this omission by examining data from a series of collections of chironomid pupal exuviae made in July 1983 in the same area as worked by ARMITAGE (1980), and by ABEL & GREEN (1981).

Locality and Methods

The River Nent rises south-west of Nenthead (NGR NY 801421) at an altitude of 656 m and flows north-westward into the River South Tyne at Alston after a course of only 16 km. The East and West Allens are a pair of very

Table 1: Sampling sites and physical and chemical data.

Site code	River and site	National Grid Ref.	Altitude m	Gradient o/oo	Width range	Chemical ranges* – pH	Ca mg/l	Zn mg/l	Pb mg/l
N1	Nent, u/s Dowgang Level	NY782434	433	33	4–5	6–7	5–10	0.5–1	<0.05
N2	Nent, d/s Dowgang Level	NY781435	432	33	4–5	7–8	10–20	1–2	<0.05
DL	Dowgang Level adit	NY782435	433	–	1	7–8	50–100	5–10	<0.05
DB	Dowgang Burn	NY780435	428	125	2–3	3–4	5–10	0.1–0.5	0.1–0.2
FB	Foreshield Burn	NY750467	338	50	2–3	7–8	20–50	<0.1	<0.05
ST	South Tyne, Bardon Mill	NY781643	90	3	80–100	7–8	10–20	<0.1	<0.05
WA1	West Allen, Corryhill Br.	NY782524	245	16	10–20	7–8	20–50	1–2	trace
WA2	West Allen, Whitfield Weir	NY782570	175	14	10–20	7–8	20–50	1–2	trace
EA1	East Allen, Rye Close Ford	NY842509	294	11	10–20	7–8	20–50	<0.2	trace
EA2	East Allen, Thornley Gate Br.	NY831567	193	10	10–20	7–8	20–50	<0.2	trace

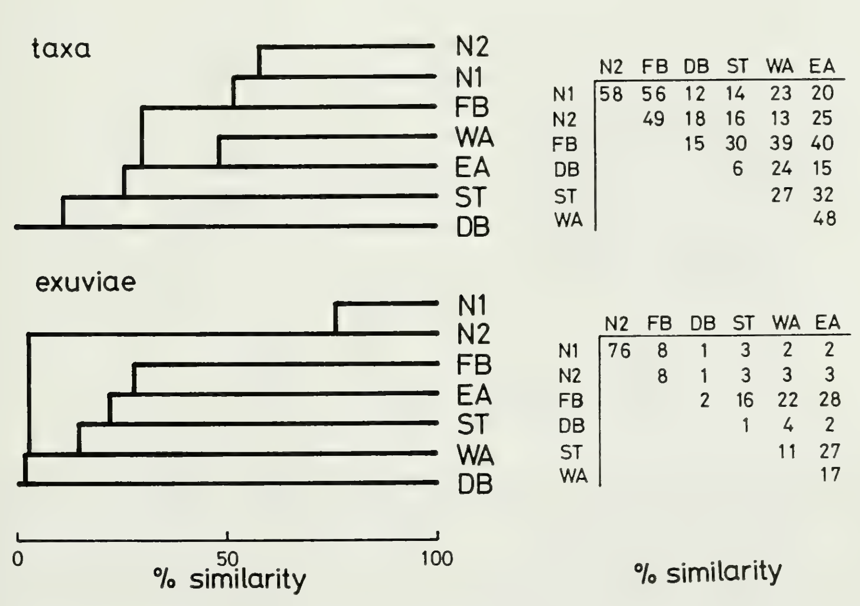
* data modified from ARMITAGE (1980), ABEL & GREEN (1981)

Table 2: List of samples from the River Nent, West and East Allen, and South Tyne, showing numbers of exuviae and taxa, and certain exuvial and diversity indices. Percentages to the nearest whole percent. KEY: N1 and N2, Nent; DL, Dowgang Level adit; DB, Dowgang Burn; FB, Foreshield Burn; ST, South Tyne; WA, West Allen; EA, East Allen; %It, %Intolerant taxa; %Ii, % Intolerant individuals; %Sedt, % Sediment-dwelling taxa; %Sedi, % Sediment-dwelling individuals; Men D, Menhinick Diversity; S-W D, Shannon-Weaver Diversity.

			Taxa indices			Exuvial indices		
Station	No. of exuviae	No. of taxa	%It	%Sedt	Men D	%Ii	%Sedi	S-W D
N1	303	13	69	31	.7	17	6	.9
N2	477	18	56	39	.8	21	11	1.3
DL	1	1	-	-	-	-	-	-
DB	51	4	0	25	.6	0	2	.4
FB	118	23	52	17	2.1	36	11	2.4
ST	225	31	71	45	2.1	74	70	2.7
WA	45	13	69	15	1.9	73	11	2.1
EA	315	37	62	22	2.1	70	24	2.6

similar rivers which rise im mediately east of the Nent (NGR: NY802442, NY860432), and flow northwards parallel to each other for 30–40 km, before joining and entering the South Tyne approximately 33 km downstream from the Nent junction.

Fig. 1 is a diagrammatic sketch-map of the area, showing the rivers and the sampling stations. The two sites on the Nent were both near the village of Nenthead, N1 approximately 200 m above and N2 300 m below the zinc-rich output from an old mine adit, the Dowgang Level; DL was on the outflow from the Dowgang Level, which flows for only about 3 m before entering the Nent; DB was on the Dowgang Burn tributary which is highly acidic (pH c.4) with effluent from an old coal mine; FB was on the Foreshield Burn tributary, which is organically enriched from a local farm but has few heavy metals; and ST was on the South Tyne. Two samples were taken from both the East (EA1, EA2) and West Allen (WA1, WA2).



	N2	FB	DB	ST	WA	EA
N1	58	56	12	14	23	20
N2		49	18	16	13	25
FB			15	30	39	40
DB				6	24	15
ST					27	32
WA						48

	N2	FB	DB	ST	WA	EA
N1	76	8	1	3	2	2
N2		8	1	3	3	3
FB			2	16	22	28
DB				1	4	2
ST					11	27
WA						17

Fig. 2: Dendrograms of percentage similarity derived from average linkage clustering of Sorensen's and Czekanowski's coefficients of similarity; A. taxa presence/absence; B. number of exuviae. The matrices of similarity from which the dendrograms are derived are also shown.

Sets of exuvial collections were made at each site over a two day period (18th and 19th July 1983) by both hand-net and surface drift-nets (similar to Brundin nets but with lateral floats, BRUNDIN, 1956; WILSON & McGILL, 1977), and all collections were lumped for each site. On the Nent and its tributaries, small drift-nets were set out overnight so as to increase the numbers of exuviae collected.

Table 3. List of species and percentage abundance found in chironomid exuvial collections from rivers in the North Pennine orefield in July 1983. Figures are whole percentages; + = <0.5%; . = absent from sample.
KEY TO SITES: N1,N2, Nent; DL, Dowgang Level adit; DB, Dowgang Burn; FB, Foreshield Burn; ST, South Tyne; WA, West Allen; EA, East Allen.

	Percentages (nearest whole percent) -								
TAXA	N1	N2	DL	DB	FB	ST	WA	EA	TOTAL
BUCHINOMYINAE									
Buchinomyia thienemanni Fitt	.	.	.	.	.	1	.	+	+
PODONOMINAE									
Paraboreochlus minutissimus (Strobl)	1	1	.	.	.	.	.	.	+
TANYPODINAE									
Macropelopia nebulosa (Mg)	.	.	.	.	.	4	.	.	1
Ablabesmyia longistyla Fitt.	.	+	.	.	.	.	.	.	+
Conchapelopia viator (K)	+	+	.	.	5	9	2	6	3
Rheopelopia maculipennis (Zett)	.	.	.	.	.	1	.	.	+
Thienemannymia laeta (Mg) Pe1/2	.	.	.	.	.	+	.	.	+
Trissopelopia longimana (Staeg)	1	.	.	.	1	.	.	.	+
DIAMESINAE									
Diamesa insignipes K	.	+	.	.	1	+	.	.	+
Diamesa thienemanni K	.	.	.	.	.	.	.	+	+
Potthastia Pe1a	1	1	.	.	.	.	.	.	+
Potthastia longimana K	.	.	.	.	.	+	.	.	+
Potthastia sp.2	.	.	.	.	.	4	.	.	1
PRODIAMESINAE									
Prodiamesa olivacea (Mg)	.	.	.	.	.	.	.	1	+
ORTHOCLADIINAE									
Brillia modesta (Mg)	.	.	.	.	6	.	.	2	1
Cardiocladius fuscus	.	.	.	.	.	.	.	+	+
Chaetocladius Pe2	+	+	100	.	1	.	.	.	+
Corynoneura spp.	.	.	.	.	4	.	.	.	+
Cricotopus (C) Pe2 ?similis Goet	.	.	.	.	.	1	.	.	+
Cricotopus (C) bicinctus (Mg)	.	.	.	.	.	.	.	+	+
Cricotopus (C) pulchripes Verr	4	10	.	.	2	.	.	.	4
Cricotopus (C) spp.	.	.	.	.	.	1	.	.	+
Cricotopus (C) tremulus (L)	.	.	.	.	.	.	.	1	+
Cricotopus (C) trifascia Edw	.	.	.	.	4	.	.	.	+
Cricotopus (I) brevipalpis (K)	.	+	.	.	.	1	.	2	1
Eukiefferiella brevicalcar (K)	.	.	.	.	.	.	.	+	+
Eukiefferiella claripennis (Lund)	+	2	.	2	30	.	13	2	4
Eukiefferiella clypeata (K)	.	.	.	.	.	.	36	1	1
Eukiefferiella coerulescens (K)	+	.	.	.	2	+	2	1	1
Eukiefferiella devonica (Edw)	.	.	.	.	.	1	9	6	2
Eukiefferiella ilkleyensis (Edw)	.	.	.	.	.	.	2	3	1
Eukiefferiella minor (Edw)	.	.	.	.	3	.	.	+	+
Heleniella ornaticollis (Edw)	5	6	.	.	1	.	.	.	3
Krenosmittia camptophleps (Edw)	78	65	.	.	5	.	.	+	36
Limnophyes spp.	.	.	.	92	.	.	.	+	3
Metriocnemus hygropetricus (K) gp.	.	.	.	.	2	.	2	+	+
Nanocladius bicolor (Zett)	.	.	.	.	1	.	.	.	+
Nanocladius rectinervis (K)	.	.	.	.	1	1	.	.	+
Orthocladius (Eudact) obtexens Brund	.	+	.	.	1	.	.	+	+
Orthocladius (Euorth) rivicola K	.	.	.	.	.	.	.	9	2
Orthocladius ?rubicundus Edw	.	.	.	.	.	.	.	1	+
Orthocladius Pe1	.	.	.	.	.	.	.	+	+
Orthocladius rhyacobius K	.	.	.	.	.	1	.	.	+
Orthocladius rubicundus sensu Edward	.	.	.	.	.	4	7	6	2
Orthocladius sp.A Pinder	.	.	.	.	.	1	.	+	+
Paracladius conversus (Walk)	+	.	.	.	.	.	.	.	+
Parametriocnemus stylatus (K)	.	.	.	.	.	+	.	.	+
Paratrichocladius rufiventris (Mg)	.	.	.	.	.	.	2	.	+
Paratrissocladius excerptus Pe1	.	+	.	.	.	.	.	.	+
Pseudorthocladius sp.	.	4	.	.	.	.	.	.	+
Pseudosmittia Pe1	.	+	.	.	.	.	.	+	+

Taxon									
Rheocricotopus chalybeatus (Edw)	.	.	.	.	1	2	.	.	+
Rheocricotopus dispar (Goet)	.	.	.	.	.	.	.	1	+
Rheocricotopus effusus (Walk)	5	4	.	.	2	.	.	+	2
Thienemannia gracilis K	.	.	.	.	.	.	.	+	+
Tvetenia calvescens (Edw)	.	.	.	.	20	4	9	29	8
Tvetenia discoloripes (Goet)	.	.	.	.	.	.	4	3	1
CHIRONOMINAE									
CHIRONOMINI									
Microtendipes spp.	.	.	.	.	.	31	.	.	5
Paratendipes Pe2	.	.	.	.	.	.	.	+	+
Polypedilum Pe2	.	.	.	.	1	.	2	1	+
Polypedilum albicorne (Mg)	4	9	.	.	1	3	.	.	4
Polypedilum cultellatum Goet	.	.	.	.	.	+	.	.	+
Polypedilum laetum (Mg)	.	.	.	.	.	.	.	+	+
TANYTARSINI									
Cladotanytarsus ?nigrovittatus Goet	.	.	.	.	.	1	.	.	+
Micropsectra aristata Pind	.	+	.	2	9	4	9	14	4
Micropsectra atrofasciata K	.	.	.	.	.	4	.	+	1
Micropsectra apposita (Walk)	.	.	.	.	.	11	.	7	3
Parapsectra nana (Mg)	.	+	.	.	.	.	.	.	+
Rheotanytarsus pentapoda K	.	.	.	.	.	+	.	.	+
Tanytarsus brundini Lind	.	.	.	.	.	4	.	.	1
Tanytarsus eminulus (Walk)	.	.	.	.	.	2	.	.	+
Tanytarsus palmeni Lind	.	.	.	.	.	4	.	.	1
TOTAL TAXA IN SAMPLE	13	18	1	4	23	31	13	37	72
TOTAL EXUVIAE IN SAMPLE	303	477	1	51	118	225	45	315	1535
TOTAL PERCENTAGE (nearest whole %)	99	102	100	96	104	100	99	96	96

Results

Most of the samples contained satisfactory numbers of exuviae, but some were numerically poor. The Dowgang Level mine adit (DL) yielded only a single exuviae, and the acid Dowgang Burn (DB) only 51 exuviae in 24 h drift-netting. The Allens were sampled with hand and drift nets for about an hour at each site, and WA1 and WA2 on the West Allen, yielded only 4 and 41 exuviae respectively; whereas the two East Allen samples EA1 and EA2 on the other hand yielded 65 and 250 exuviae. It was therefore decided to lump EA1 and EA2, and WA1 and WA2, together for analysis, forming a single composite sample for each of the East Allen (EA) and the West Allen (WA).

Table 1 gives some basic parameters such as altitude, slope of site, and grid reference for each site, as well as chemical data derived from the papers by Armitage (1980) and Abel & Green (1981) which illustrate the chemical conditions. Table 2 shows the numbers of exuviae and identified taxa found in each sample together with certain exuvial and diversity indices. Table 3 gives the complete species list found in the samples in taxonomic order, while Table 4 lists only those species which were found making up 5 % or more of the exuviae in any one sample.

Fig. 2 shows the dendrograms plotted from data from average linkage clustering of the species collected from each site, using Sørensen's and Czekanowski's coefficients of similarity for taxa presence/absence and numbers of individual exuviae respectively.

Discussion

The cluster analysis data (see Fig. 2) show that the two Nent sites (N1, N2) are very similar in both taxa and numbers of exuviae (N1:N2 taxa, 58 %; exuviae, 76 %). They are also closely linked to the Foreshield Burn (FB) by taxa presence/absence (N1:N2, 58 %; N1:FB, 56 %; N2:FB, 49 %), but not by numbers of individual exuviae (N1:FB, 8 %; N2:FB, 8 %). Similarly the West Allen and the East Allen are similar in taxa (WA:EA, 48 %) but not in numbers of exuviae (WA:EA, 17 %). The zinc-enriched sites also show a lower diversity of species (N1: Menhinick, 0.7; Shannon, 0.9; N2: Menhinick, 0.8; Shannon, 1.3) in contrast to the higher diversity in the low-zinc sites (FB: Menhinick, 2.1, Shannon, 2.4; EA: Menhinick, 2.1; Shannon, 2.6).

Table 4: Table of principal species (>5% in any sample) in the Nent, East and West Allen, and South Tyne. Figures to the nearest whole percent. KEY: N1 and N2, Nent; DB, Dowgang Burn; FB, Foreshield Burn; ST, South Tyne; WA, West Allen; EA, East Allen; + = <0.5%; . = absent from sample.

Species	Percentages –						
	N1	N2	DB	FB	ST	WA	EA
Krenosmittia camptophleps (Edw)	78	65	.	5	.	.	+
Heleniella ornata (Edw)	5	6	.	1	.	.	.
Cricotopus (C) pulchripes Verr	4	10	.	2	.	.	.
Polypedilum albicorne (Mg)	4	9	.	1	3	.	.
Limnophyes spp.	.	.	92	.	.	.	+
Eukiefferiella claripennis (Lund)	+	2	2	30	.	13	2
Tvetenia calvescens (Edw)	.	.	.	20	4	9	29
Micropsectra aristata Pinder	.	+	2	9	4	9	14
Brillia modesta (Mg)	.	.	.	6	.	.	2
Conchapelopia viator (K)	+	+	.	5	9	2	6
Microtendipes spp.	.	.	.	.	31	.	.
Micropsectra apposita (Walk)	.	.	.	.	11	.	7
Eukiefferiella clypeata (K)	.	.	.	.	.	36	1
Eukiefferiella devonica (Edw)	.	.	.	.	1	9	6
Orthocladius (ss) rubicundus Edw	.	.	.	.	4	7	6
Orthocladius (Euorth) rivicola K	.	.	.	.	.	.	9
Total taxa in sample	13	18	4	23	31	13	37
Total exuviae examined	303	477	51	118	225	45	315

If the taxa composition is similar between comparable zinc-enriched and low-zinc sites, but the abundances of individual species differs, and the diversity is lower at the enriched sites, then it seems possible that the fauna of the zinc-enriched sites (N1, N2 and WA), comprise those species that have higher tolerance of the zinc, and represent subsets of the unpolluted chironomid communities of these rivers. The low-zinc sites (FB and EA) may exemplify the unpolluted fauna.

It is important, however, to note that the species found in the zinc-enriched Nent were very different from those in the similarly zinc-enriched West Allen. The Nent samples (N1 and N2) were dominated by *Krenosmittia camptophleps* (Edwards) (78 % and 65 %), but also contained substantial numbers of *Heleniella ornata* (Edwards) (5 % and 6 %), *Cricotopus (C.) pulchripes* Verrall (4 % and 10 %) and *Polypedilum albicorne* (Meigen) (4 % and 9 %): in contrast, the West Allen samples (WA) were dominated by *Eukiefferiella clypeata* (Kieffer) (36 %) and *Eukiefferiella claripennis* (Lundbeck) (13 %), and did not contain any of the four species characteristic of the Nent.

It appears therefore that the Nent and the Allens, although adjacent and similar stony rivers, differ in some way meaningful to the Chironomidae. It is therefore not possible from these samples to designate a characteristic "zinc-tolerant" community of chironomid species, which might be found wherever zinc-enrichment occurs, in the same way that a characteristic "organic-tolerant" community may be defined which is linked to organic enrichment in many different rivers and situations. Zinc-tolerance may develop in a number of different species, selected as appropriate from those available at the particular site.

It is well-known that chironomid communities differ in different sections of a single river, and that different communities are found associated with different gradients and substrates (Thienemann, 1954; Kownacki & Kownacka, 1972). The Nent sites N1, N2 and FS have gradients of from 30–50 ‰, whereas the sites on the Allens have gradients of from 10–16 ‰. It is possible therefore that the chironomid communities found in the Nent are characteristic of higher gradients than those of the Allens, even though the rivers are basically similar.

The dominant species in the Nent in samples N1 and N2, *Krenosmittia camptophleps, Heleniella ornata, Cricotopus (C.) pulchripes* and *Polypedilum albicorne* are all characteristic of upland streams and often associated with hygropetric conditions (Cranston, 1982; Wiederholm, 1983; Langton, 1984). In contrast, *Eukiefferiella* and *Tvetenia* spp., which dominate the samples from the West Allen, are nor-

mally more abundant at lower altitudes, and especially where there is increased growth of moss (HUMPHRIES & FROST, 1937; THIENEMANN, 1954; CRANSTON, 1982; LANGTON, 1984).

The calcium concentrations in the the Nent were lower than in the Allens (see Table 1). It is widely held that heavy metals are less toxic in calcium-rich water than in acid, low calcium water (HYNES, 1960; WARREN, 1971; WHITTON & SAY, 1975; MASON, 1981), and this effect may influence the response of the chironomids to the river conditions.

The sample from the acid Dowgang Burn (c. pH 4) is quite different from all the other samples, and is dominated by *Limnophyes* spp. (92%). The single exuviae from the very short outfall from the Dowgang Level, which has a high zinc content of 5–10 mg/l, was a *Chaetocladius* sp. (Pe2 in LANGTON, 1984), also found in low numbers in the Nent and the Foreshield Burn. The River South Tyne at Bardon Mill Ford is a much larger river with more fine sediment, and has a much lower gradient (3 ‰) than the Nent and Allens, and this is reflected in the dominance of sediment-living taxa such as *Microtendipes* spp. and *Micropsectra apposita* (Walker) found in the sample (31% and 11%, respectively). In the cluster analysis, the South Tyne sample (ST) showed closest similarity with the Foreshield Burn (ST:FB taxa, 30%; exuviae, 16%) and with the East Allen (ST:EA taxa, 32%; exuviae, 27%), but the linkage is weak. As the South Tyne has a low zinc content (<0.1 mg/l), it it might be expected to link with the other low-zinc sites.

More data is required before the ideas advanced in this paper can be considered valid, but it is hoped that they will point the way to further, more detailed, work using chironomid pupal exuviae on the effects of heavy metals on chironomid communities.

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Zwei neue Smittia-Arten aus dem süddeutschen Raum

(Diptera, Chironomidae)*)

Von **N. Caspers**

Abstract

Two new species of the genus *Smittia* Holmgren are described from southern Germany. The description of *Smittia scutellosetosa* n. sp. is based on several male (and one female) imagines, that of *Smittia amoena* n. sp. on one male only. Both species are characterized by the peculiar shape of the male genitalia. Larvae and pupae are unknown. Most probably the larvae settle in dry, gravelly sediments of river banks in southern Germany.

Einleitung

Die weltweit verbreitete Gattung *Smittia* Holmgren umfaßt ausschließlich Arten mit terrestrischen bzw. hygrophilen Larvenstadien. Die Gattungszugehörigkeit der Arten im Imaginalstadium ist leicht am Besitz einer kräftigen Subapikalborste auf dem Antennenendglied der Männchen erkennbar. Lediglich die nearktische *Saetheriella amplicristata* Halvorsen besitzt ebenfalls eine Subapikalborste auf dem Antennenendglied; die Analspitze ist jedoch bei dieser Art im Gegensatz zu den Arten des Genus *Smittia* kurz und breit (Halvorsen 1982). Die infragnerische Gliederung des Taxons *Smittia* bereitet zur Zeit noch außerordentliche Schwierigkeiten. Die enorm hohe Artenzahl, die oft nur subtilen Unterschiede in der Genitalmorphologie der Männchen, vielleicht auch die etwas ungewöhnlichen Habitate vieler *Smittia*-Arten vereitelten bis zum heutigen Tage die Durchführung einer dringend benötigten Revision des Gattungskomplexes. Die Abbildungen und Beschreibungen in der älteren Literatur – insbesondere bei Goetghebuer (1940–1950) – sind aus heutiger Sicht völlig unzureichend und nicht für eine gültige Differenzierung der Arten verwendbar. Zur Zeit sollte eine Beschreibung neuer *Smittia*-Arten sinnvollerweise nur dann vorgenommen werden, wenn eindeutige und auffällige Merkmale ihre Eigenständigkeit herausstellen. In der vorliegenden Arbeit werden zwei derartige *Smittia*-Arten mit besonders markantem Hypopygbau beschrieben.

Smittia scutellosetosa spec. nov.
(Abb. 1–5)

Fundort: Isarinsel bei Aumühle (Nähe Schäftlarn in Oberbayern, Bundesrepublik Deutschland).

Material: Holotyp ♂, Barberfalle, 26.5.1982, leg. M. Baehr; in coll. Zoologische Staatssammlung München (Objektträgerpräparat gemäß Schlee 1966). Paratypen: 3 ♂♂, mit gleichen Funddaten wie der Holotyp; 6 ♂♂, Aumühle, Barberfalle, 13.5.1983, leg. M. Baehr (in sehr schlechtem Erhaltungszustand); 1 ♂, Gerolfing (Nähe Ingolstadt, Bundesrepublik Deutschland), Barberfalle, 3.5.1983, leg. M. Baehr; 1 ♂, Weichering (Nähe Ingolstadt), Barberfalle, 6.5.1982, leg. M. Baehr.

Alle Paratypen werden in der Zoologischen Staatssammlung München aufbewahrt.

*) mit finanzieller Unterstützung der Deutschen Forschungsgemeinschaft

Diagnose: Die neue Art ist insbesondere durch genitalmorphologische Merkmale hinreichend gekennzeichnet: extrem lange Analspitze ohne Mikrotrichien in der apikalen Hälfte; caudad gebogene, fast digitiforme Basalloben; Gonostylen abweichend von allen bisher beschriebenen *Smittia*-Arten: Crista dorsalis abgerundet, extrem stark vorgewölbt. Auffällig ist darüberhinaus auch die intensive Beborstung des Skutellums.

Imago ♂ (Holotypus), Terminologie wie bei Saether (1980). Daten der Paratypen als Klammerzusätze.

Körperlänge 2,72 mm (2,44–2,83). Flügellänge 1,83 mm (1,74–1,82). Verhältnis Körperlänge/Flügellänge 1,49 (1,41–1,59). Verhältnis Flügellänge/Länge des Profemur 3,02 (3,00–3,22). Färbung von Thorax und Abdomen einheitlich dunkelbraun.

Kopf. Länge des Antennenendgliedes 507 μm (432–520). AR 1,88 (1,57–1,84). Augen behaart, dorsalwärts mäßig verlängert. Temporal- und Postorbitalborsten (nicht deutlich voneinander differenziert): 8 (8–10). 4 (2–6) Clypeusborsten. Länge der Palpenglieder (Mikrometer): 24 (22–24), 50 (44–46), 104 (88–96), 88 (80–88), 102 (84–90).

Thorax. Antepronotum wie bei anderen *Smittia*-Arten entwickelt, mit 2 lateralen Borsten. 21 (14–21) Dorsocentralborsten, zum Teil in doppelter Reihe. Anzahl der Acrostichalborsten (= Dorsomedianborsten) beim Holotypus wegen Seitenlage der Thoraxpartie nicht bestimmbar; bei den Paratypen wurden bis zu 15 Acrostichalborsten gezählt, die weit vorne am Pronotum beginnen. 5 (5–8) Präalarborsten. Anzahl der Skutellarborsten beim Holotypus wegen Seitenlage des Thorax nicht exakt zu ermitteln; bei den Paratypen bis zu 21 (!) Skutellarborsten von verhältnismäßig geringer Größe vorhanden.

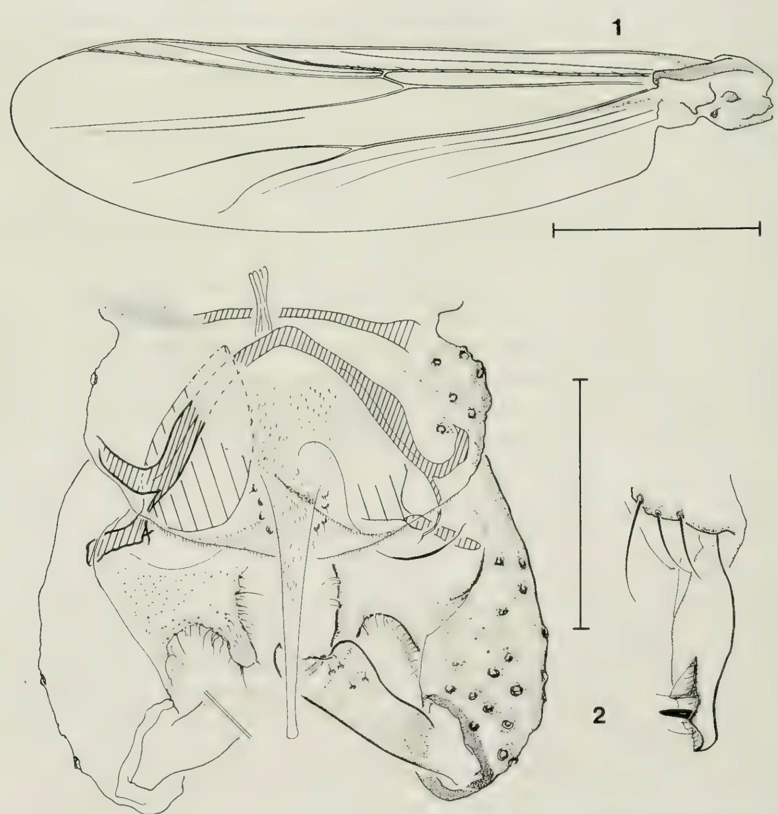


Abb. 1 u. 2: *Smittia scutellosetosa* ♂: 1. Flügel, Maßstab ≙ 0,5 mm; 2. Hypopygium (dorsal), Maßstab ≙ 0,1 mm.

Flügel (Abb. 1). VR ca. 1,0. Verlängerung der Costa (jenseits der Mündung von R_{4+5}): 86 μm (76–104). Brachiolum mit 1 Borste (1–2). 3 (3) Borsten auf R_1, 7 (8–13) Borsten auf R_{4+5}, 13 (3–13) Borsten auf R.

Beine. Sporn der Vordertibia 44 μm (42–52) lang, Sporne der Mitteltibien 20 μm (18–22) und 22 μm (20–28) lang, Sporne der Hintertibien 22 μm (20–22) und 50 μm (48–52) lang. Breite der Vordertibia im distalen Bereich: 32 μm (32–34); Breite der Mitteltibia im distalen Bereich: 32 μm (32); Breite der Hintertibia im distalen Bereich: 42 μm (42–48). Tibialkamm mit 10 (9–12) Borsten, die kürzesten 26 μm (24–26), die längsten 40 μm (40–42) lang.

Länge (Mikrometer) der Beinglieder und Längenrelationen:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR	BV	SV
P_1	592 545 - 598	740 697 - 748	357 321 - 387	229 205 - 241	144 134 - 144	98 92 - 104	84 80 - 86	0,48 0,46-0,52	3,04 3,01-3,06	3,73 3,48-3,87
P_2	653 626 - 700	669 639 - 700	273 261 - 289	158 148 - 168	116 112 - 120	80 78 - 80	80 76 - 84	0,41 0,41	3,68 3,63-3,74	4,84 4,81-4,85
P_3	700 651 - 724	772 700 - 780	405 381 - 421	221 196 - 225	172 158 - 182	92 88 - 100	90 84 - 94	0,53 0,54-0,55	3,26 3,13-3,29	3,64 3,50-3,57

Abdomen. Die Beborstung der Abdominaltergite wurde nur bei einem Paratypus überprüft. Die Anzahl der Borsten auf den Tergiten I–VIII betrug: 28, 62, 67, 55, 52, 47, 40, 50. Beim gleichen Individuum betrug die Anzahl der Borsten auf den Sterniten I–VIII: 0, 0, 11, 14, 26, 26, 24, 23.

Hypopygium (Abb. 2). Länge der Analspitze 94 μm (90–94). Länge des Gonocoxits 156 μm (140–172). Länge des Gonostylus 90 μm (80–92). Griffel 13 μm (12–14) lang. Virga 26 μm (26–28) lang. HR 1,73 (1,59–1,95). HV 3,02 (2,77–3,54).

Ökologie. Die Jugendstadien von *Smittia scutellosetosa* spec. nov. liegen nicht vor. Es ist jedoch mit großer Wahrscheinlichkeit davon auszugehen, daß Habitate im unmittelbaren Umfeld der exponierten Barberfallen, in denen die Imagines gefangen wurden, besiedelt werden.

Das Untersuchungsgebiet auf hochgelegenen Kiesbänken im Auengebiet der Isar ist in der Tat ein ungewöhnlicher Lebensraum für terrestrische Chironomiden – oder wohl richtiger: ein bisher wenig



Abb. 3: *Smittia scutellosetosa* ♀: Kopf, Maßstab ≙ 0,2 mm.

beachteter und entsprechend wenig besammelter Lebensraum: auf engstem Raum kommt es hier unter dem prägenden Einfluß der ökologischen Faktoren Temperatur und Bodenfeuchte/-trocknis zur Bildung eines vielgestaltigen Biotopmosaiks, in dem bei überraschend hohen Artenzahlen vor allem xerophile Faunenelemente – z. B. bei den Arachniden und Carabiden (mündl. Mitt. M. Baehr) – eine wichtige Rolle spielen. Die knapp bemessene Zufuhr von Wasser beschränkt sich auf gelegentliche Regenfälle und nächtliche Tauniederschläge, die von einer lückigen Moosdecke für kurze Zeit gespeichert werden können, ansonsten aber im kiesig-sandigen Untergrund rasch versickern. Nur bei extremen Hochwässern der Isar ist in größeren Zeitabständen mit kurzfristigen Überflutungen dieser Standorte zu rechnen.

Imago ♀

Ob die hohe Zahl der Skutellarborsten bei *Smittia scutellosetosa* spec. nov. differentialdiagnostische Wertigkeit hat, kann angesichts des unrevidierten Status der Gattung *Smittia* zur Zeit nicht endgültig entschieden werden. Hinweise, die dies jedoch richtig erscheinen lassen, ergeben sich bei Durchsicht der umfangreichen Belegsammlung des Autors an westpaläarktisch verbreiteten *Smittia*-Sippen: alle hierauf überprüften Arten wiesen 2 bis maximal 8 Skutellarborsten auf.

Im Rahmen von Emergenz-Studien (Caspers 1980, 1983) gefangene *Smittia*-Arten, bei denen infolge übereinstimmender phänologischer Daten eine direkte Zuordnung von Männchen und Weibchen möglich war, zeigten darüberhinaus keine bedeutenden geschlechtsspezifischen Unterschiede in der Skutellarbeborstung an.

Es spricht somit einiges dafür, daß die Skutellarbeborstung der neuen *Smittia*-Art ein hochwertiges diagnostisches Merkmal darstellt und daß es sich bei dem nachstehend beschriebenen *Smittia*-Weibchen (mit 20 Skutellarborsten) aus einer Barberfalle bei Aumühle um das Weibchen von *Smittia scutellosetosa* handelt:

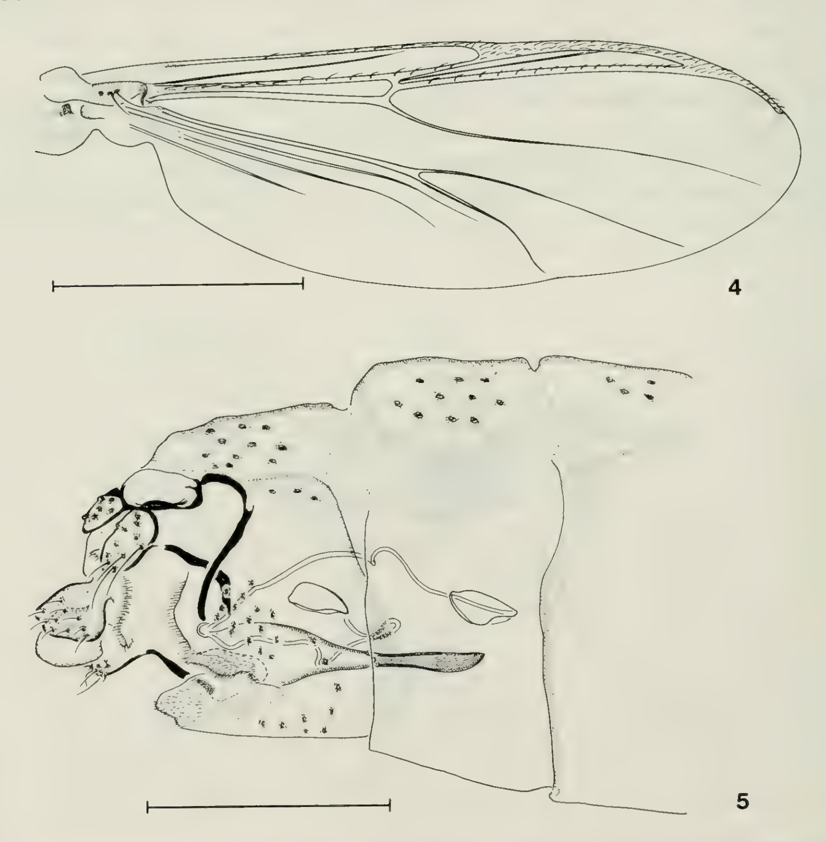


Abb. 4 u. 5: *Smittia scutellosetosa* ♀: 4. Flügel, Maßstab ≙ 0,5 mm; 5. Genital (ventrolateral), Maßstab ≙ 0,2 mm.

Körperlänge 2,30 mm. Flügellänge 1,54 mm. Verhältnis Körperlänge/Flügellänge 1,49. Verhältnis Flügellänge/Länge des Profemur 3,29. Färbung von Thorax und Abdomen einheitlich dunkelbraun.

Kopf (Abb. 3). Länge und Breite des Pedicellus (Mikrometer): 48/56. Länge und Breite der Flagellomeren 1–5 (Mikrometer): 68/31, 46/26, 46/24, 46/24, 66/23. Temporal- und Postorbitalborsten (nicht deutlich voneinander differenziert): 10. 6 Borsten auf dem Clypeus. Länge der Palpenglieder (Mikrometer): Länge der Palpenglieder 1 und 2 bei dem vorliegenden Objektträger-Präparat nicht exakt meßbar; Palpenglied 3: 83. 4: 64. 5: 80.

Thorax. Antepronotum wie im männlichen Geschlecht ausgebildet. 30 bzw. 38 Dorsocentralborsten, 12 Acrostichalborsten. 16 bzw. 15 Präalarborsten. 22 kleine Skutellarborsten.

Flügel (Abb. 4). Verlängerung der Costa (jenseits der Mündung von R_{4+5}): 168 μm. Brachiolum mit 3 Borsten. R_1 mit 6 Borsten, R_{4+5} mit 24 Borsten, R mit 16 Borsten.

Beine. Sporn der Vordertibia 31 μm lang, Sporne der Mitteltibien 18 und 22 μm lang, Sporne der Hintertibien 12 und 30 μm lang. Breite der Vordertibia im distalen Bereich: 32 μm; Breite der Mitteltibia im distalen Bereich: 32 μm; Breite der Hintertibia im distalen Bereich: 42 μm. Tibialkamm mit 11 Borsten, die kürzesten 24 μm, die längsten 38 μm lang.

Länge (Mikrometer) der Beinglieder und Längenrelationen:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR	BV	SV
P_1	476	516	221	144	94	68	72	0,43	3,21	4,49
P_2	570	535	205	124	96	62	72	0,38	3,70	5,39
P_3	582	610	331	168	146	76	78	0,54	3,25	3.60.

Abdomen. Anzahl der Borsten auf den Abdominaltergiten I–VII: 48, 49, 40, 34, 29, 39, 47. Anzahl der Borsten auf den Abdominalsterniten I–VII: 0, 8, 13, 21, 22, 20, 38.

Genitalien: Abb. 5.

Smittia amoena spec. nov.
(Abb. 6–7)

Fundort: Kiesbänke in der Flußaue der Donau bei Gerolfing (Nähe Ingolstadt, Bundesrepublik Deutschland).

Material: Holotyp ♂, Barberfalle, 3.5.1983, leg. M. Baehr; in coll. Zoologische Staatssammlung München (Objektträgerpräparat).

Diagnose: Auch *Smittia amoena* weist ein vom üblichen *Smittia*-Typ stark abweichendes Hypopyg-Merkmal hoher differentialdiagnostischer Wertigkeit auf: die hyaline Crista dorsalis ist deutlich ausgeprägt und extrem stark vorgewölbt.

Imago ♂ (Holotypus)

Körperlänge 2,44 mm. Flügellänge 1,54 mm. Verhältnis Körperlänge/Flügellänge 1,58. Verhältnis Flügellänge/Länge des Profemur 2,87. Färbung von Thorax und Abdomen einheitlich dunkelbraun.

Kopf. Länge des Antennenendglieds 374 μm. AR 1,15. Augen behaart, dorsalwärts nicht verlängert. 1 innere, 2 äußere Temporalborsten; soweit am Typusexemplar erkennbar, keine Postorbitalborsten. Clypeus mit 2 Borsten. Länge der Palpenglieder (Mikrometer): 1 nicht meßbar am Typusexemplar; 40, 78, 76, 64.

Thorax. Antepronotum fehlt am Typusexemplar. 12 Dorsocentralborsten in einfacher Reihe. Acrostichalborsten beginnen vorne am Pronotum, am Typusexemplar sind 4 deutliche Borsten erkennbar. 6 Präalarborsten, die vorderen schwächer ausgebildet als die hinteren. Anzahl der Skutellarborsten am Typusexemplar nicht deutlich erkennbar, mindestens 4 Borsten vorhanden.

Flügel (Abb. 6). R_{2+3} erreicht nicht ganz die Costa. Verlängerung der Costa (jenseits der Mündung von R_{4+5}): 80 μm. Brachiolum ohne Borsten. 6 Borsten auf R_1, 6 Borsten auf R_{4+5}, 6 Borsten auf R.

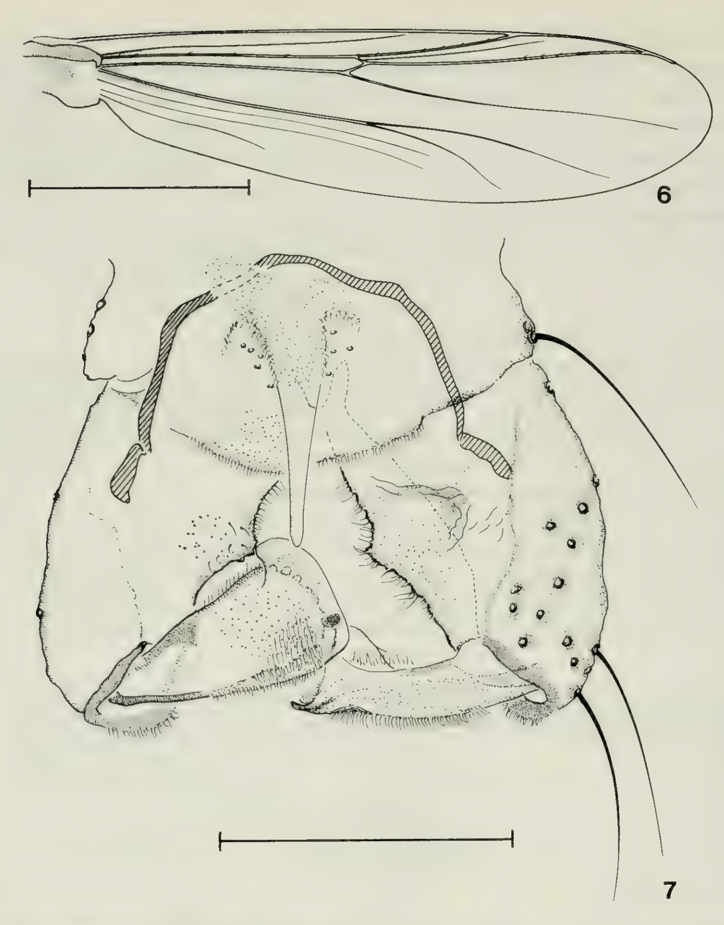


Abb. 6 u. 7: *Smittia amoena* ♂: 6. Flügel, Maßstab ≙ 0,5 mm; 7. Hypopygium (dorsal), Maßstab ≙ 0,1 mm.

Beine. Sporn der Vordertibia 42 μm lang, Sporne der Mitteltibien 16 und 20 μm lang, Sporne der Hintertibien 20 und 48 μm lang. Breite der Vordertibia im distalen Bereich: 30 μm; Mitteltibia: 32 μm; Hintertibia: 40 μm. Tibialkamm mit 9 Borsten, 20 bis 40 μm lang.

Länge (Mikrometer) der Beinglieder und Längenrelationen:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR	BV	SV
P_1	538	645	297	182	130	84	84	0.46	3.08	3.98
P_2	620	613	233	132	110	68	78	0.38	3.78	5.29
P_3	632	661	357	166	156	88	88	0.54	3.31	3.62

Abdomen. Die Beborstung der Abdominaltergite und -sternite ist am Objektträger-Präparat des Typusexemplars nicht genau zu bestimmen, entspricht aber offensichtlich etwa der Beborstung von *Smittia scutellosetosa.*

Hypopygium (Abb. 7). Länge der Analspitze 88 μm. Länge des Gonocoxits 162 μm. Länge des Gonostylus 96 μm. Griffel 8 μm lang. Innere Skleritstrukturen des Hypopygiums am Typusexemplar nicht in Einzelheiten erkennbar. HR 1,69. HV 2,54.

♀ Imago nicht bekannt.

Ökologie. Auch bei dieser neuen Art ist zu vermuten, daß der Lebensraum der – vorerst nicht bekannten – terrestrischen Larven in der Nähe der Barberfallen-Standorte zu suchen ist: die männlichen Imagines der *Smittia*-Arten zeichnen sich – soweit dies bekannt ist – nicht durch auffällige Flugaktivität bzw. einen größeren Aktionsradius aus.

Von seinen allgemeinen physiographischen Verhältnissen ähnelt der Standort „Kiesbänke/Donau-Auwald bei Gerolfing" dem Locus classicus von *Smittia scutellosetosa* am Isarufer bei Aumühle. Auf den ersten Blick ist der im Vergleich noch stärker xerotherme Charakter an schütteren Wacholder- und Kiefernbeständen auf weitgehend vegetationsfreiem Untergrund erkennbar. Auch bei Betrachtung der ökologischen Standortansprüche epigäischer Raubarthropoden (mündl. Mitt. M. Baehr) ergibt sich eine eindeutige Dominanz wärmeliebender Arten.

Es ist davon auszugehen, daß der Fundort von *Smittia amoena* – ca. 200 m Entfernung von der Donau bei Normalwasserstand – auch bei extremen Hochwasserbedingungen nicht überflutet wird.

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Rheomus, un nouveau genre du complexe Harnischia avec deux nouvelles espèces d'Afrique du Nord

(Diptera, Chironomidae)

Henri Laville et **Friedrich Reiss**

Abstract

Rheomus, a new genus of the Harnischia complex with two new species from North Africa (Diptera, Chironomidae)

Rheomus, a new genus of the Harnischia complex is established for two new species from North Africa. The imago ♂, the pupal exuvia, of *R. yahiae* recorded in Morocco and Tunisia and the imago ♂ of *R. alatus* only recorded in Morocco are described. From the imaginal characteristics, *Saetheria* seems the most related genus but the pupal characteristics are rather related with the genus *Cryptotendipes.* Nevertheless, its throw-back anal lobe is a very original one among Chironomini.

Introduction

L'étude des Chironomidés récoltés par dérive dans un affluent rive droite de l'Oued Medjerda (Tunisie) par M. Boumaiza nous a permis d'isoler une nymphe ♂ originale dont 3 imagos ♂, déjà connus du Maroc et conservés à la Zoologische Staatssammlung München, se rangent dans le complexe *Harnischia.*

Les caractères nettement régressifs du lobe anal de la nymphe autorisent la création d'un nouveau genre avec deux nouvelles espèces connues seulement d'Afrique du Nord.

Nous remercions M. M. Boumaiza (Université de Tunis) pour le leg du matériel de Tunisie.

Rheomus gen. nov.

L'espèce type est *Rheomus yahiae* spec. nov.

Imago ♂:

Petit, longueur de l'aile 1,2–1,65 mm. Yeux nettement prolongés dorsalement et juste séparés de la longueur du prolongement. Tubercules frontaux cyclindriques présents. Antenne avec 11 flagellomères, AR = 1,2–1,3. Palpes normaux, non raccourcis. Nombre de soies thoraciques peu élevé en rapport avec la petite taille du corps; soies acrostichales présentes. Scutum avec tubercule. Aile avec lobe anal três peu développé, squama seulement avec 2–3 soies. FCu éloignée distalement de RM, C se terminant avant M et non prolongée au-delà de R4+5. Seule R avec quelques courtes soies, les autres nervures sans soies. Surface alaire sans soies ni taches. Pattes normales non raccourcies. Grosses pulvilles présentes. Peignes du tibia plats, courts et non séparés avec seulement un court éperon.

Hypopyge avec un tergite anal à bandes assez superficielles réunies par une zone brunâtre dans la partie médiane. Pointe anale longue, en forme de raquette et nue. Tergite anal sans soies médianes, avec des soies apicales écartées de la base de la pointe anale. Volsella supérieure en forme de pied ou de massue, à membrane souple, avec ou sans tubercule apical, sans soies dorsales, avec 2–3 longues soies ventrales issues d'une zone à microtriches. Volsella inférieure de taille petite à moyenne, garnie de longues microtriches se prolongeant loin vers sa base tout le long du bord interne du gonocoxite. Gonocoxite avec seulement 3 longues soies médianes marginales. Gonostyle effilé, avec dans sa moité apicale une lamelle dorsale ou médiane, une zone dorsobasale dépourvue de microtriches, une dent apicale absente et des soies médianes en partie fourchues distalement.

Nymphe:

Seule la nymphe de *R. yahiae* est connue. Sa description ci-après peut également servir de générotype.

Répartition et écologie

Le genre *Rheomus* est actuellement connu d'Afrique du Nord (Maroc et Tunisie).

Il s'agit probablement d'éléments faunistiques du Potamal dont les larves colonisent de préférence les sédiments sableux des grands cours d'eau.

Diagnose différentielle

L'imago ♂ de *Rheomus* se differencie des autres représentants du complexe *Harnischia* surtout par la combinaison des caractères suivants de l'hypopyge: bandes du tergite anal droites pratiquement non réunies dans la partie médiane dépourvue de soies; pointe anale longue, en forme de raquette et nue; Volsella supérieure en forme de pied ou de massue, dorsalement nue et avec deux longues soies ventrales dans une zone de microtriches; Volsella inférieure de longueur courte à moyenne; gonocoxite avec une lamelle dorsale ou médiane dans sa moité apicale. De plus, l'imago possède des tubercules frontaux, de longues soies acrostichales (dorsomédianes), un petit tubercule scutal ainsi que des peignes du tibia non séparés et avec un seul petit éperon sur P_{II} et P_{III}. *Rheomus* se distingue du genre en apparence le plus proche, *Saetheria* Jackson, 1977 par la présence d'un seul éperon tibial court à la place de deux éperons forts, par la présence d'un petit tubercule scutal, absent chez *Saetheria*, par des bandes en forme de V, pratiquement séparées dans la partie médiane du tergite anal et en forme de Y chez *Saetheria*, par l'absence de soies médianes sur le tergite anal (présentes en petit nombre chez *Saetheria* et insérées à l'extrémité distale des bandes du tergite anal), par une pointe anale fortement élargie distalement en forme de raquette (légèrement élargie chez *Saetheria)* par une Volsella supérieure dorsalement nue (en 2 lobes séparés: le distal couvert de microtriches, le basal sans microtriches), enfin par la présence d'une lamelle dorsale ou médiane dans la partie terminale du gonostyle, absente chez *Saetheria*.

Nymphe: nous renvoyons à la diagnose différentielle de la nymphe de *R. yahiae*.

Rheomus yahiae spec. nov.

Imago ♂:

Taille: petit, longueur de l'aile 1,35–1,65 mm.

Coloration: corps brun (dans l'alcool). Vittae (bandes mésonotales) brun foncé ainsi que les 2/3 postérieurs du postnotum, le praeepisternum et une tache sur l'anepisternum.

Tête: yeux fortement prolongés dorsalement et séparés dans la partie médiane de la longueur du prolongement. Tubercules frontaux cylindriques, jusqu'à 10 µm de long. Antenne avec 11 flagellomères, AR = 1,22. Longueur des articles 2–5 des palpes en µm (Holotype): 27, 106, 124, 189.

Thorax: avec 5 soies acrostichales, 5–8 dorsocentrales, 2–3 préalaires et 6–7 scutellaires. Scutum avec un petit tubercule arrondi.

Aile: lobe anal peu développé. Squame avec seulement 2–3 soies. FCu éloignée distalement de RM, C non prolongée au-delà de R4+5 et finissant avant M. R2+3 débouchant au 1/3 proximal entre R1 et R4+5. Seule R porte 3–5 soies.

Pattes: longueur des articles en μm (Holotype):

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5
P_I	600	460	630	305	235	170	100
P_{II}	540	540	200	130	100	70	80
P_{III}	610	640	370	210	175	100	90

LR = 1,32–1,37. Pulvilles presque aussi longs que les griffes. Tarses antérieurs non barbus. Sensilla chaetica non visible sur le Ta_I de P_{II}. Peignes des tibias moyens et postérieurs plats, courts, non séparés, avec seulement un court éperon.

Hypopyge (fig. 1): bandes du tergite anal en V, assez superficielles, ne se rejoignant pas dans la partie médiane où une simple zone brunâtre les relie. Pointe anale à base étroite et partie terminale arrondie en forme de disque, un peu recourbée ventralement (fig. 1 a). Partie basale plus courte que la partie terminale. Tergite anal sans soies médianes, soies apicales légérement écartées de la base de la pointe et regroupées en touffe. Volsella supérieure en forme de pied latéralement déporté. Partie distale à membrane d' apparence délicate, sans soies dorsales, avec 2–3 soies ventrales issues d'une zone de microtriches.

Volsella inférieure arrondie distalement, très courte, n'atteignant pas la base du gonostyle.

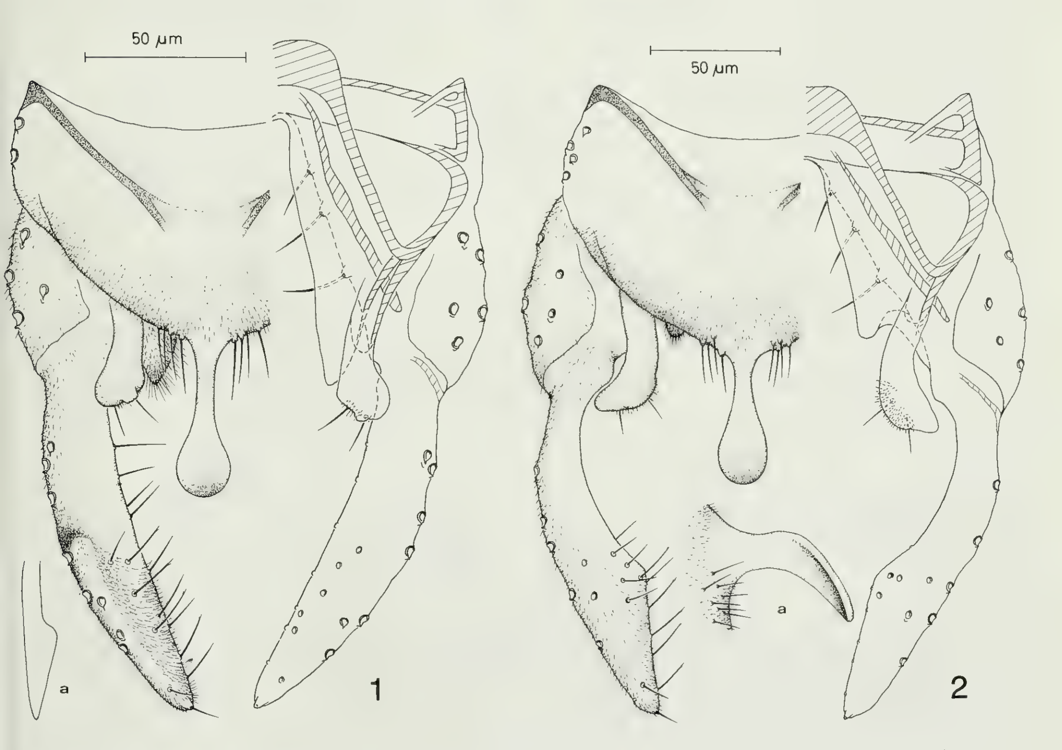


Fig. 1. *Rheomus yahiae* spec. nov., Hypopyge dorsal. a. Pointe anale, vue latérale. Fig. 2. *Rheomus alatus* spec. nov., Hypopyge dorsal, a. Gonostyle, vue latérale.

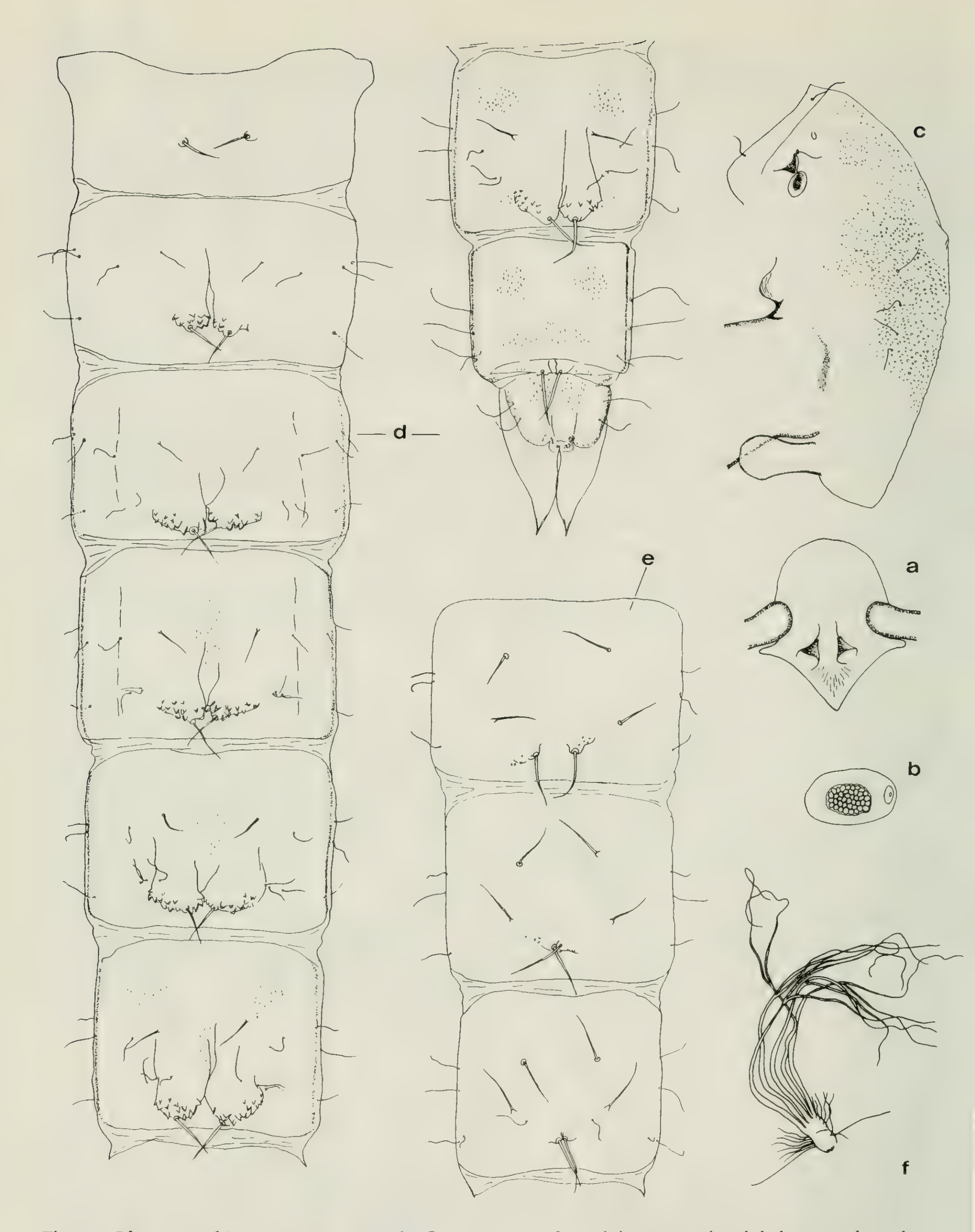


Fig. 3. *Rheomus yahiae* spec. nov., Nymphe ♀. a. Apotome frontal. b. Anneau basal de la corne thoracique. c. Thorax. d. Tergites abdominaux I-VIII. e. Sternites V-VIII, f. Corne thoracique.

La Volsella inférieure se raccorde tout le long du bord interne du gonocoxite. Gonocoxite avec seulement 2–3 longues soies médianes et marginales. Gonostyle avec une partie basale étroite, un bord interne très concave, une partie distale élargie et aplatie en lame de couteau, progressivement rétrécie vers l'apex. Partie distale du gonostyle entièrement couvert de microtriches, partie basale avec une zone dorsale dépourvue de microtriches; soies du bord interne partiellement fourchues à leur extrémité.

Imago ♀: inconnue.

Nymphe ♀:

Longueur 3,2–3,7 mm (n = 8). Exuvie pratiquement incolore.

Céphalothorax (fig. 3 a): soies frontales courtes, fines, insérées à l'extrémité de petits tubercules céphaliques coniques. Tubercules frontaux absents. Corne thoracique de type Chironomini, caractéristique (l = 0,7–0,9 mm): formée par 5 branches bifurquées dans leur moitié distale en branches plus fines, avec á sa base une touffe de filaments courts et fins; anneau basal ovale avec une structure alvéolaire bien visible (fig. 3 b, f). En avant de l'anneau, présence d'un processus conique légèrement coloré.

Thorax finement granuleux dorsalement, par ailleurs lisse (fig. 3 c). Tubercule préalaire développé en projection conique courte et plissée. Tubercule du scutum peu développé. Fourreau alaire, aux bords légèrement colorés, sans nez ni perles. Soies thoraciques: 2 précornéales, 2 antépronotales, 4 dorsocentrales.

Abdomen (fig. 3 d, e): tergite I nu; II–VII avec une paire de tubercules médio-postérieurs garnis d'épines courtes et portant une forte soie plus chitinisée. Tergite II sans rangée de crochets. Conjonctif et pleures sans chagrin; fin chagrin aux angles antérieurs des tergites VI, VII, VIII, sur la partie médiane des tergites III-VI ainsi que sur la moitié antérieure du segment anal. Pedes spurii A absents; Pedes spurii B aux angles antérieurs du segment I, absents du segment II. Sternites pratiquement sans chagrin avec deux lobules postérieurs portant chacun une longue soie plus chitinisée; quelques spinules seulement présentes près des lobules des sternites V et VI. Segment VIII sans épines ni éperons à l'angle postérieur. Segment anal avec deux lobes allongés, terminés par une pointe effilée et recourbée ventralement, avec chacun deux L setae insérées au tiers antérieur. Sac génital ♀ distalement trilobé.

Sétation abdominale: segments II-VII avec 3 L setae courtes. Segment VIII avec 3 L setae plus longues. 4 L setae observées sur un côté d'une seule exuvie. La sétation des tergites et des sternites V–VII est représentée sur la figure 3 d et 3 e.

Matériel: Holotype 1 imago ♂, Maroc, S. Yahia Boka, juin 1967, leg. Choumara. Paratypes: 3 imagos ♂♂ du locus typicus, 20. 4. 1967 et juin 1967.

Maroc: 1E♀ Oued Fès, 20. 12. 1987, leg. Azzouzi. Tunisie: 1N♂, 5E♀ Oued Tessa, 15. 5. 1983; 1E♀ Oued Medjerda (Jendouba) 12. 4. 1985; 2E♀ Oued Medjerda (Bathan), 6. 4. 1985, leg. Boumaiza.

L'Holotype se trouve dans la Zoologische Staatssammlung München. Paratypes dans la collection H. Laville, Toulouse et dans Z. S. M. Tous les exemplaires sont montés dans l'Euparal.

Répartition et écologie

R. yahiae est connue du Maroc et de Tunisie.

Au Maroc, la station de l'Oued Fès, petit affluent (22 km) de l'Oued Sebou, est située 3 km en amont de Fès et à 380 m d'altitude: elle est large de 13 m, profonde de 0,8–1 m, avec un substrat de gravier et de sable grossier; la température de l'eau était de 22° C le 20 avril 1986.

Deux stations tunisiennes se situent dans le principal fleuve du Nord de la Tunisie l'Oued Medjerda, la troisième dans l'Oued Tessa, 2 km en amont de sa confluence avec la Medjerda.

Il s'agit de cours d'eau de plaine (28 m–146 m), larges (8–12 m), à fond sableux à sablo-vaseux, avec des températures de 24° C en juin et de 12° C en février. La végétation bordante est rare ou absente. Dans l'Oued Medjerda, près de Jendouba, l'espèce a été récoltée en compagnie de l'espèce *Kloosia pusilla* (L.) (12. 4. 85) et s'avère, comme cette dernière, un nouvel exemple d'un élément faunistique du potamal au sein du complexe *Harnischia*.

Diagnose diffèrentielle

L'imago ♂ se différencie bien de l'imago ♂ de *alatus* au niveau des caractères de l'hypopyge: Volsella supérieure en forme de pied, sans tubercule (en forme de massue avec un petit tubercule apical); gonostyle avec un bord interne nettement concave et une moitié distale élargie en lame de couteau (bord interne droit avec une lamelle latérodistale sur la face dorsale). De plus, *yahiae* est de coloration nettement plus foncée que *alatus*.

La nymphe de *R. yahiae* se caractérise par un segment anal d'un type original et apparement unique chez un Chironomini: de plus, la réduction de la sétation anale à 2 simples L setae le rapprocherait de celui d'un Tanypodinae. Seulement 3 L setae aux segments V–VIII (normalement 4 LS setae chez le complexe *Harnischia).*

Rheomus alatus spec. nov.

Imago ♂:

Taille: petit, longueur de l'aile 1,2–1,35 mm.

Coloration: corps brun-jaune (dans l'alcool). Vittae brun, bien séparées. Postnotum brun avec une étroite bande basale plus claire. Praeepisternum, une tache sur l'anepisternum, pedicellus, articles 2–4 du palpe, également brun; article 5 brun clair. Balanciers clairs. Tergites abdominaux I–VI avec une bande médio-longitudinale brune. Pattes entièrement brunes excepté la base du fémur antérieur plus claire et les fémurs moyens et postérieurs clairs avec toutefois une bande longitudinale brune.

Tête: yeux fortement prolongés dorsalement et séparés dans la partie médiane de la longueur du prolongement. Tubercules frontaux cylindriques, jusqu'à 16 μm de long. Antenne avec 11 flagellomères, AR = 1,17–1,33 (n = 3). Longueur des articles 2–5 des palpes en μm (Holotype): 38, 88, 103, 133.

Thorax: avec 6 soies acrostichales, 5–7 dorsocentrales, 3–4 préalaires et 6–7 scutellaires. Scutum avec un petit tubercule arrondi.

Aile: lobe anal peu développé. Squame avec seulement 2 soies. FCu éloignée distalement de RM, C non prolongée au-delà de R4+5 et finissant avant M. R2+3 débouchant au 1/3 proximal entre R1 et R4+5. Seule R porte 4–6 soies.

Pattes: longueur des articles en μm (Holotype):

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5
P_I	480	365	460	235	170	120	75
P_{II}	420	415	150	95	70	55	60
P_{III}	490	500	265	150	126	65	70

LR = 1,26–1,40 (n = 2). Pulvilles presque aussi longs que les griffes. Tarses antérieurs non barbus. 2 sensilla chaetica subapicales sur Ta_1 de P_{II}. Peignes des tibias moyens et postérieurs plats, courts, non séparés, avec seulement un court éperon.

Hypopyge (fig. 2): bandes du tergite anal en V, assez superficielles, ne se rejoignant pas dans la partie médiane oú une simple zone brunâtre les relie. Pointe anale à base étroite et partie terminale élargie en forme de disque, un peu recourbée ventralement. Partie basale presque aussi longue que la partie terminale. Tergite anal sans soies médianes, soies apicales légèrement écartées de la pointe et regroupées en touffe. Volsella supérieure étroite, presque droite, élargie distalement et avec une ébauche de tubercule apical; dorsalement sans soies et avec 2 longues soies subapicales dans une zone de microtriches sur la face ventrale. Volsella inférieure triangulaire et effilée, de longueur moyenne, atteignant la partie basale du gonostyle et garnie de très longues microtriches. La Volsella inférieure se raccorde tout le long du bord interne du gonocoxite. Gonocoxite avec seulement 3 longues soies médianes et

marginales. Gonostyle avec un bord interne droit, légèrement élargi au centre; la partie distale avec au bord externe une lamelle peu apparente en vue dorsale, seulement visible en position latérale (fig. 2 a); soies du bord interne partiellement fourchues à leur extrémité.

Imago ♀, Nymphe et Larve: inconnues.

Matériel: Holotype 1 imago ♂, Maroc, Meknès, 553 m N. N., 23. 8. 1979, leg. G. Fontain. Paratypes: 1 imago ♂, Maroc, Haut-Atlas du Sud, Oasis Meski, 1160 m N. N., 2. 5. 1979, leg. F. Auer & K. Werner; 2 imagos ♂♂, Maroc, Oued Tensift, rive Sud, Palmeraie de Marrakech, 10. 5. 1979, leg. D. Masson.

Les préparations à l'Euparal de l'Holotype et du Paratype premier nommé se trouvent dans la Zoologische Staatssammlung München, les deux autres Paratypes dans la collection H. Laville, Toulouse.

Répartition et écologie

L'espèce n'est jusqu'ici connue que du Maroc. Son écologie n'est pas connue.

Diagnose différentielle

L'espèce se différencie du second représentant du genre *(yahiae)* par les caractères suivants de l'hypopyge: Volsella supérieure en forme de massue et avec une ébauche de tubercule apical (en forme de pied, sans tubercule); gonostyle avec un bord interne droit et une lamelle latéro-distale peu apparente dorsalement, bien visible en vue latérale (bord interne, en partie concave, et lamelle médio-distale en lame de couteau).

Discussion

Les caractères imaginaux montrent (voir diagnose différentielle du genre) que *Rheomus* se rapproche le plus du genre *Saetheria* qui, de son côté, a montré de grandes affinités avec le genre *Paracladopelma* Harnisch, 1923. Malgré la présente description d'un nouveau genre au sein de ce groupe parental, les limites du genre doivent rester provisoires, car d'une part, un grand nombre d'espèces dont les stades jeunes sont inconnus diffèrent beaucoup du générotype et d'autre part, plusieurs espèces non décrites existent dont l'analyse des caractères peut amener des transformations taxonomiques. L'appartenance douteuse au genre existe pour *Paracladopelma mikiana* (Goetgh., 1973) espèce Ouest-Paléarctique, ainsi que pour les trois espèces afrotropicales *P. melutense* (Freem., 1957), *P. pullata* (Freem., 1957) et *P. reidi* (Freem., 1957). Une nymphe ♂ de l'espèce essentiellement afrotropicale *P. graminicolor* (Kieff., 1929), récemment trouvée à la Zoologische Staatssammlung, s'est révélée appartenir nettement au genre *Cryptotendipes* Lenz, 1941. *Paracladopelma tamanipparai* Sasa, 1983 du Japon, d'aprés la description originale et les figures se range sans aucun doute dans le genre *Saetheria.* Ces quelques exemples justifient la nécessité de nouvelles études taxonomiques dans cette partie du complexe *Harnischia.*

La nymphe présente une corne thoracique caractéristique de type Chironomini.

L'absence de rangée de crochets au tergite II et l'absence de peignes ou d'éperons latéro-postérieurs au segment VIII la rapproche du genre *Harnischia* (Pinder & Reiss 1986). L'ornementation des tergites abdominaux I–VIII ressemble davantage à celle du genre *Cryptotendipes.*

L'absence de parenté réelle de la nymphe avec quelques genres de la tribu des Chironomini interdit toute spéculation phylogénétique. La forte régression du segment anal de la nymphe de *R. yahiae* incite à considérer le genre *Rheomus* comme autapomorphe.

L'écologie de *R. yahiae,* comparable à celle des genres *Kloosia* et *Demicryptochironomus (Irmakia)* (Reiss 1988 a, b), est un nouvel exemple d'un genre potamobionte au sein du complexe *Harnischia.*

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A Contribution to the knowledge of Chironomids in Italy

(Diptera, Chironomidae)

By **B. Rossaro**

Abstract

In recent years Chironomid research in Italy has developed greatly. 359 species have been recorded. The subfamilies are represented by 42 Tanypodinae, 23 Diamesinae, 3 Prodiamesinae, 143 Orthocladiinae, 148 Chironominae, 59 belong to the tribe Tanytarsini and 89 to Chironomini. Another 45 taxa tentatively identified must be added to these. Most species are widely distributed in the Palearctic region. Few Mediterranean (6), Afrotropical (5) or Panpaleotropical (3) species have been found. The list includes five previously considered to be Nearctic species, which have Holarctic distribution according to the present evidence.

Introduction

Chironomid research in Italy is very active. In the last ten years the number of species known to be present has gone up steeply. Information was very scanty before 1968, grew slowly up to 1976, then quickly. One important stimulus has been a series of volumes with identification keys for the aquatic fauna published by the Italian National Research Council (C. N. R.). Four volumes deal with Chironomids: Ferrarese & Rossaro (1981), Rossaro (1982), Ferrarese (1983) & Nocentini (1985). Only the larvae of all subfamilies and the pupal exuviae of all subfamilies except Chironominae are considered in these volumes. The literature about Chironomids in Italy has been reviewed by Rossaro (1979) and Ferrarese (1982).

The interests in Chironomid research are three. There are systematic, zoogeographic and ecological problems that stimulate the study. Italy is in the centre of the Mediterranean area and is a natural bridge between Central Europe and Africa. There are several very different biotopes in Italy: cold springs and glacier streams in the Alps, large lakes in the pre-Alps (Garda, Maggiore, Como), rivers in the Padana lowland (Po, Adige, Ticino, Adda, etc.), Mediterranean streams in central and southern Italy. A very long list of species was to be expected and this is indeed the case, although at present it is very incomplete. The first reason is that no extensive sampling effort has been made. Pollution is the second reason. The capture of springs and the creation of reservoirs for water supply are also unfavourable factors for the preservation of autochthonous, highly diversified fauna. Eury-topic and eury-ecious species are favoured. The large spread of insecticides and water drainage to fight malaria in the Mediterranean countries after the second World War destroyed the species living in marshes. Obviously, pollution is not exclusive to Italy, but in some very urbanized areas it has certainly drastically modified the species composition, favouring the more common ones more than elsewhere. The massive development of *Chironomus salinarius* in the Venetian and Orbetello lagoons is an example (Ali & Majori 1984).

The list of species in a country must be continuously updated, as new species are captured. Genera are submitted to revision, synonyms are created, species change names obeying the principle of priority. Some species can be easily identified thanks to peculiar morphological characters, but it is diffi-



Fig. 1. Location of sampling sites in Italy. Only the sites sampled most intensely indicated.

1— Cold springs and glacier streams in Aosta valley (Valle d'Aosta)
2— Ortles-Adamello group; many different biotopes, springs, streams, small lakes, all above 1 000 m, etc. (Lombardia and Trentino-Alto Adige)
3— the Ticino river near Turbigo and Boffalora (Lombardia)
4— Springs near Milano, called "fontanili" and the Lambro (Lombardia)
5— prealpine streams near Bergamo (Brembo and Serina) (Lombardia)
6— the Po River near Trino Vercellese (Torino) and Casale Monferrato (Piemonte)
7— the Po River between Piacenza and Cremona (Emilia Romagna)
8— Mantova lakes, along the Mincio river (Mantova) (Lombardia)
9— Reno and other streams on the northern side of the northern Apennines (Emilia Romagna)
10— the Potenza near Macerata (Marche)
11— the Aso near San Benedetto del Tronto (Marche)
12— Springs and streams in Parco Nazionale Abruzzi (Abruzzi e Molise)
13— Occhito artificial basin between Molise and Puglia, and the Fortore in Molise
14— the Cedrino and other small stream in northern Sardinia (Sardegna)
15— Rio Mannu and brackish waters in southern Sardinia (Sardegna)
16— Dirillo artificial basin and the Dirillo (Sicilia)

cult to give names to species belonging to genera that requiere revision such as *Chaetocladius*, *Bryophaenocladius*, *Smittia*, *Micropsectra atrofasciata* group, *Microtendipes*, *Cryptochironomus*, etc.. Therefore, the list in this paper represents only a transitory phase in our developing knowledge.

Methods, sampling sites

The list of species is based on determinations on adult males in most cases. Sometimes determinations are made on pupal exuviae. Larvae were obtained alive from some sites (always from sites 4 and 7, sometimes from other sites, see Figure 1) and reared to adults in the laboratory. In laboratory-reared material one can associate larvae and pupae with the adults and this procedure is highly recommended. For species determination in the genus *Chironomus*, salivary gland chromosomal analysis was carried out *C. annularius*, *C. anthracinus*, *C. melanotus* and *C. riparius* were identified by this technique.

Sampling efforts were made in different regions in Italy, but Lombardia has been the most intensively sampled. Figure 1 is a map showing the sites at which the most intensive sampling was carried out. Each sampling site includes many different stations and covers a large area. In each sampling site, captures were made throughout the year. Sites that were sampled only at intervals are not reported in Figure 1.

Collecting was done with hand-nets, light traps, surface drift nets.

Results and Discussion

Table 1 lists the known species in Italy. It has been necessary to separate them into the following groups:

1 – Species well described and identifiable: within this group, we further separate:

1 a – species present in the author's collection (Department of Biology, University of Milan): they are marked with + in Table 1;

1 b – species as 1 a, new for Italian fauna: they are marked with =;

1 c – species reported in the literature as present in Italy, but not in the author's collection; this material is deposited in different collections and it has not been possible for the author to verify the validity of all these findings. All these species are marked with £. In this group, species determinations before 1950 are especially dubious.

2 – Species whose presence is unsure because:

2 a – determinations were made on ill-preserved specimens or only pre-imaginal stages are available;

2 b – species belong to genera that require revision.

Species belonging to 2 a – and 2 b – are marked with *.

Table 1: Chironomidae taxa from Italy (see text for explanation)

Tanypodinae

+ *Clinotanypus nervosus* (Mg.)
£ *Tanypus kraatzi* (K.)
+ *T. punctipennis* (Mg.)
+ *T. villipennis* (K.)
* *Procladius choreus* (Mg.)
* *P. sagittalis* K.
+ *Apsectrotanypus trifascipennis* (Zett.)
+ *Macropelopia fehlmanni* (K.)
£ *M. goetghebueri* (K.)
+ *M. nebulosa* (Mg.)
£ *M. notata* (Mg.)
+ *M.* sp. Schweiz
£ *Natarsia punctata* (Fabr.)
+ *Psectrotanypus varius* (Fabr.)
+ *Alabesmyia longistyla* Fitt.
£ *A. monilis* (L.)
+ *Arctopelopia griseipennis* (v. d. W.)
+ *Krenopelopia binotata* (Wied.)
£ *Conchapelopia melanops* (Wied.)
+ *C. pallidula* (Mg.)
+ *Monopelopia tenuicalcar* (K.)
+ *Paramerina divisa* (Walk.)
+ *P. cingulata* (Walk.)

∗ *P.* sp. A
= *Rheopelopia acra* Roback
= *R. maculipennis* (Zett.)
+ *R. ornata* (Mg.)
= *Telopelopia fascigera* Verneaux
= *Thienemannimyia carnea* (Fabr.)
= *T. fuscipes* (Edw.)
+ *T. geijskesi* (G.)
= *T. northumbrica* (Edw.)
£ *T. pseudocarnea* Murray
= *T. woodi* (Edw.)
+ *Xenopelopia falcigera* (K.)
= *Telmatopelopia nemorum* (G.)
£ *Trissepelopia longimana* (Staeg.)
+ *Zavrelimyia barbatipes* (K.)
£ *Z. hirtimana* (K.)
+ *Z. melanura* (Mg.)
£ *Z. nubila* (Mg.)
£ *Z. punctatissima* (G.)
+ *Z. signatipennis* (K.)
£ *Larsia atrocincta* (G.)
£ *Nilotanypus dubius* (Mg.)

Diamesinae

= *Boreoheptagyia cinctipes* Edw.
+ *Pseudodiamesa branickii* (Now.)
+ *P. nivosa* (G.)
+ *Syndiamesa nigra*
+ *Diamesa dampfi* (K.)
+ *D. permacer* (Walk.)
+ *D. steinboecki* (G.)
= *D. longipes* G.
+ *D. latitarsis* (G.)
+ *D. goetghebueri* Pag.
∗ *D. lindrothi* G.
∗ *D. laticauda* Ser.-Tos.
∗ *D. modesta* Ser.-Tos.
+ *D. bertrami* Edw.
+ *D. aberrata* (Lundb.)
∗ *D.* sp. A
+ *D. incallida* (Walk.)
+ *D. insignipes* K.
+ *D. cinerella* (Mg.)
+ *D. thienemanni* K.
+ *D. vaillanti* Ser.-Tos.
+ *D. zernyi* Edw.
+ *Pseudokiefferiella parva* (Edw.)
+ *Potthastia gaedii* (Mg.)
+ *P. longimanus* K.
+ *Sympotthastia spinifera* Ser.-Tos.

Prodiamesinae

+ *Prodiamesa olivacea* (Mg.)
+ *P. rufovittata* (G.)

∗ *Monodiamesa* sp.
+ *Odontomesa fulva* (K.)

Orthocladiinae

= *Diplocladius cultriger* K.
= *Euryhapsis annuliventris* (Mall.)
+ *Brillia longifurca* K.
+ *B. modesta* (Mg.)
= *Cardiocladius capucinus* (Zett.)
= *C. fuscus* K.
+ *Tvetenia bavarica* (G.)
+ *T. calvescens* (Edw.)
+ *T. discoloripes* (G.)
+ *T. verralli* (Edw.)
∗ *T. scanica* (Br.)
+ *Eukiefferiella gracei* (Edw.)
+ *E. coerulescens* (K.)
+ *E. devonica* (Edw.)
+ *E. ilkleyensis* (Edw.)
+ *E. fittkaui* Lehm.
+ *E. minor* (Edw.)
= *E. brehmi* Gow.
+ *E. cyanea* Th.
+ *E. clypeata* (K.)
+ *E. pseudomontana* G.
∗ *E. dittmari* Lehm.
+ *E. fuldensis* Lehm.
+ *E. lobifera* G.
+ *E. brevicalcar* (K.)
+ *E. tirolensis* G.
+ *E. hospita* Edw.
+ *Tokunagaia rectangularis* (G.)
+ *T. tonollii* (Ross.)
+ *Psectrocladius (Psectrocladius) psilopterus* K.
= *P. (P.) brehmi* K.
= *P. (P.) edwardsi* Br.
= *P. (P.) limbatellus* (Holm.)
= *P. (Monospectrocladius) octomaculatus* Wülk.
= *P. (M.) schlienzi* Wülk.
∗ *P. (Allopectrocladius)* gr. *dilatatus*
= *Rheocricotopus (Psilocricotopus) atripes* (K.)
+ *R. (P.) chalybeatus* (Edw.)
= *R. (P.) glabricollis* (Mg.)
+ *R. (Rheocricotopus) effusus* (Walk.)
+ *R. (R.) fuscipes* (K.)
+ *Paracricotopus niger* (K.)
£ *Nanocladius balticus* Pal.
+ *N. bicolor* (Zett.)
+ *N. rectinervis* (K.)
= *N. spiniplenus* Saether
+ *Parorthocladius nudipennis* (K.)
+ *Synorthocladius semivirens* (K.)
+ *Orthocladius (Eudactylocladius) fuscimanus* (K.)
= *O. (E.) gelidus* (K.)

+ *O. (E.) olivaceus* (K.)
+ *O. (E.)* sp. A
= *Orthocladius (Euorthocladius) ashei* Soponis
+ *O. (E.) frigidus* (Zett.)
+ *O. (E.) luteipes* (G.)
+ *O. (E.) rivicola* (K.)
+ *O. (E.) rivulorum* (K.)
+ *O. (E.) saxosus* (Tok.)
+ *O. (E.) thienemanni* (K.)
+ *Orthocladius (Orthocladius) excavatus* Br.
+ *O. (O.) rubicundus* (Mg.)
* *O. (O.) tubicula* K.
= *O. (O.) wetterensis* Br.
+ *O. (O.)* sp. A Pinder
+ *O. (O.)* Pe 1 Langhton
* *O. (O.)* Pe 10 Langhton
+ *Symposiocladius lignicola* (K.)
+ *Acricotopus lucens* (Zett.)
+ *Paratrichocladius rufiventris* (Mg.)
+ *P. skirwithensis* (Edw.)
* *P.* sp. A
+ *Paracladius conversus* (Walk.)
* *P. alpicola* (Zett.)
+ *Halocladius stagnorum* (G.)
+ *H. varians* (Staeg.)
= *Cricotopus (Cricotopus) polaris* K.
= *C. (C.) tibialis* (Mg.)
+ *C. (C.) fuscus* (K.)
+ *C. (C.) tremulus* (L.)
+ *C. (C.) annulator* G.
= *C. (C.) curtus* Hirv.
= *C. (C.) pulchripes* Verr.
+ *C. (C.) triannulatus* (Macq.)
= *C. (C.) cilindraceus* (K.)
= *C. (C.) patens* Hirv.
= *C. (C.) festivellus* (K.)
+ *C. (C.) bicinctus* (Mg.)
+ *C. (C.) vierriensis* G.
+ *C. (C.) trifascia* Edw.
= *Cricotopus (Isocladius) ornatus* (Mg.)
+ *C. (I.) sylvestris* (Fabr.)
= *C. (I.) glacialis* Edw.
+ *C. (I.) trifasciatus* (Mg.)
+ *C. (I.) intersectus* (Staeg.)
+ *C. (I.) tricinctus* (Mg.)
= *Hydrobaenus distylus* (K.)
= *Zalutschia tatrica* (Pag.)
+ *Metriocnemus fuscipes* (Mg.)
+ *M. hirticollis* (Staeg.)
= *M. hygropetricus* K.
= *Thienemannia gracilis* K.
= *Chaetocladius dissipatus* (Edw.)
* *C. gelidus* Br.
= *C. laminatus* Br.
= *C. perennis* (Mg.)
£ *C. setilobus* Marc.
= *C. suecicus* (K.)
+ *Paratrissocladius fluviatilis* (G.)
= *Heterotrissocladius marcidus* (Walk.)
* *H. grimshavi* (Edw.)
+ *Parametriocnemus stylatus* (K.)
= *P. boreoalpinus* Gow.
* *P. eoclivus* Saether
= *Paraphaenocladius impensus* (Walk.)
+ *Parakiefferiella gracillima* (K.)
£ *P. bathophila* (K.)
£ *P. coronata* (Edw.)
+ *Epoicocladius* sp. A
+ *Rheosmittia spinicornis* Br.
+ *Krenosmittia boreoalpina* (G.)
+ *K. camptophleps* (Edw.)
+ *K.* sp. A (? = *hispanica* Wülk.)
+ *Stilocladius montanus* Ross.
+ *Heleniella dorieri* Ser.-Tos.
+ *H. ornaticollis* (Edw.)
* *H.* sp. A
+ *Parachaetocladius abnobaenus* Wülk.
= *Limnophyes bidumus* Saether n. sp. (Saether in press)
+ *L. minimus* (Mg.)
= *L. natalensis* K.
= *Pseudorthocladius curtistylus* (G.)
= *Gymnometriocnemus subnudus* Edw.
£ *G. volitans* (G.)
* *Bryophaenocladius aestivus* Br.
* *B. illimbatus* Edw.
* *B. inconstans* (Br.)
* *B. scanicus* Br.
* *B. subvernalis* (Edw.)
* *B. tuberculatus* (Edw.)
* *B. vernalis* (G.)
* *Smittia aterrima* (Mg.)
£ *S. edwardsi* G.
* *S. foliacea* (K.)
£ *S. giordani-soikai* Marc.
£ *S. gridellii* Marc.
£ *S. littorella* G.
£ *S. malarodai* Marc.
* *S. nudipennis* G.
* *S. pratorum* G.
= *Parasmittia carinata* Str.
= *Camptocladius stercorarius* (d. Geer.)
= *Mesosmittia flexuella* (Edw.)
£ *Pseudosmittia angusta* Edw.
+ *P. d'anconai* (Marc.)
£ *P. gracilis* (G.)
+ *P. holsata* T. & Str.
£ *P. mathildae* Albu
= *P. recta* Edw.
= *P. subtrilobata* (Freem.)

£ *P. trilobata* (Edw.)
* *Georthocladius* sp. A
* *Thienemanniella clavicornis* K.
* *T. obscura* Br.
= *T. partita* Schlee
= *Corynoneura coronata* (Edw.)
+ *C. edwardsi* Br.
= *C. fittkaui* Schlee
= *C. lacustris* Edw.
= *C. lobata* Edw.
+ *C. scutellata* Winn.

Chironominae

Tanytarsini

* *Zavrelia pentatoma* K.
£ *Zavreliella marmorata* (v. d. W.)
£ *Stempellinella brevis* Edw.
£ *Stempellina bausei* (K.)
£ *S. subglabripennis* Br.
£ *Neozavrelia fuldensis* Fitt.
£ *Tanytarsus bathophilus* (K.)
+ *T. brundini* Lind.
+ *T. buchonius* Reiss & Fitt.
£ *T. chinyensis* G.
£ *T. curticornis* K.
+ *T. eminulus* Walk.
+ *T. fimbriatus* Reiss & Fitt.
= *T. gracilentus* Holm.
+ *T. heusdensis* G.
£ *T. horni* G.
= *T. lestagei* G.
+ *T. lugens* K.
£ *T. miriforceps* K.
+ *T. nemorosus* Edw.
+ *T. nigricollis* G.
+ *T. pallidicornis* Walk.
£ *T. recurvatus* Br.
+ *T. sylvaticus* v. d. W.
= *T. usmaensis* Pag.
+ *Virgatanytarsus maroccanus* (Kügler & Reiss)
+ *V. triangularis* (G.)
+ *Stilotanytarsus inquilinus* Krüger
= *Cladotanytarsus atridorsum* (K.)
£ *C. mancus* (Walk.)
+ *Rheotanytarsus curtistylus* G.
= *R. montanus* Lehm.
£ *R. muscicola* K.
£ *R. nigricauda* Fitt.
+ *R. pentapoda* K.
+ *R. photophilus* G.
+ *R. ringei* Lehm.
+ *Paratanytarsus austriacus* K.
+ *P. bituberculatus* (Edw.)
+ *P. confusus* Pal.
£ *P. inopertus* (Walk.)
+ *P. lauterborni* K.
+ *P. mediterraneus* Reiss & Sawedal
£ *P. penicillatus* G.
= *P. tenellulus* (G.)
+ *Micropsectra (Lauterbornia) coracina* K.
£ *Micropsectra apposita* (Walk.)
+ *M. atrofasciata* K.
= *M. attenuata* Reiss
+ *M. bidentata* G.
= *M. clastrieri* Reiss
£ *M. groenlandica* And.
= *M. junci* (Mg.)
£ *M. lindrothi* G.
£ *M. miki* Marc.
+ *M. notescens* (Walk.)
£ *M. pharetrophora* Fitt.
+ *M. recurvata* G.
£ *M. roseiventris* K.
= *M. tenellula* G.

Pseudochironomini

* *Pseudochironomus prasinatus* (Staeg.)

Chironomini

£ *Pagastiella orophila* (Edw.)
£ *Paratendipes albimanus* (Mg.)
+ *P. nubilus* (Mg.)
= *P. plebejus* (Mg.)
+ *Microtendipes britteni* Edw.
+ *M. chloris* K.
* *M. diffinis* Edw.
+ *M. pedellus* (de Geer)
£ *M. tarsalis* (Walk.)
£ *Nilothauma (= Kribioxenus) brayi* (G.)
£ **Paralauterborniella nigrohalteralis* (Mall.)
+ *Phaenopsectra flavipes* (Mg.)
= *P. punctipes* (Wiedemann)
+ *Polypedilum (Pentapedilum) nubens* Edw.
+ *P. (P.) sordens* (v. d. W.)
+ *Polypedilum (Polypedilum) acutum* K.
+ *P. (P.) albicorne* (Mg.)
+ *P. (P.) convictum* (Walk.)
+ *P. (P.) cultellatum* G.
+ *P. (P.) laetum* (Mg.)
+ *P. (P.) nubeculosum* (Mg.)
* *P. (P.) pedestre* (Mg.)
£ *P. (P.) nubifer* (? = *aberrans* Chern.) (Skuse)
+ *Polypedilum (Tripodura) acifer* Townes
+ *P. (T.) aegyptium* (? = *pruina* Freeman) K.
+ *P. (T.) apfelbecki* (? = *elongatum* Albu) (Strobl.)
+ *P. (T.) bicrenatum* K.
£ *P. (T.) breviantennatum* Chern.

£ *P. (T.) pullum* (Zett.)
\+ *P. (T.) quadriguttatum* K.
\+ *P. (T.) scalaenum* Schr.
\+ *Endochironomus albipennis* (Mg.)
£ *E. dispar* (Mg.)
£ *E. lepidus* (Mg.)
\+ *E. tendens* Fabr.
* *Stictochironomus pictulus* (Mg.)
\+ *Stenochironomus ranzii* Ross.
£ *S. gibbus* Fabr.
= *S. spatuliger* K.
* *Fleuria lacustris* K.
= *Dicrotendipes lobiger* K.
\+ *D. nervosus* (Staeg.)
\+ *D. notatus* (Mg.)
= *D. peringueyanus* Freem.
£ *D. pulsus* (Walk.)
\+ *D. tritomus* K.
* *Glyptotendipes gripekonveni* K.
* *G. pallens* (Mg.)
* *G. paripes* Edw.
£ *G. severini* G.
\+ *Camptochironomus pallidivittatus* (Mall.)
\+ *Chironomus annularius* (Mg.)
\+ *C. anthracinus* Zett.
\+ *C. calipterus* K.
£ *C. cingulatus* (Mg.)
£ *C. dorsalis* (Mg.)
= *C. melanotus* Keyl
\+ *C. obtusidens* G.
\+ *C. plumosus* L.
\+ *C. riparius* Mg.
\+ *C. salinarius* K.
\+ *Kiefferulus tendipediformis* G.
\+ *Halliella noctivaga* K.
£ *Einfeldia carbonaria* Mg.
= *E. longipes* (Staeg.)
£ *E.* gr. *pagana*
* *Sergentia* sp.
\+ *Xenochironomus xenolabis* K.
£ *Cladopelma edwardsi* Krus.
\+ *C. virescens* (Mg.)
\+ *C. viridula* (Fabr.)
\+ *Cryptotendipes holsatus* Lenz
\+ *Microchironomus tener* K.
\+ *Parachironomus arcuatus* G.
\+ *P. longiforceps* K.
= *P. monochromus* (v. d. W.)
\+ *P. parilis* (Walk.)
\+ *P. varus* G.
\+ *P. vitiosus* G.
\+ *Paracladopelma camptolabis* K.
£ *P. nigritula* G.
* Genus near *Paracladopelma*
\+ *Harnischia angularis* Albu & Botn.
\+ *H. curtilamellata* (Mall.)
\+ *H. fuscimana* (K.)
£ *Demicryptochironomus vulneratus* (Zett.)
\+ *Cryptochironomus albofasciatus* (Staeg.)
\+ *C. defectus* K.
\+ *C. obreptans* (Walk.)
\+ *C. rostratus* K.
\+ *C. supplicans* (Mg.)
\+ "*Cryptochironomus*" sp. Pagast
\+ *Saetheria* sp. 1 Jackson
£ *Chernovskiia macrocera* (Chern.)
\+ Genus near *Robackia*
\+ *Robackia pilicauda* Saether
= *Beckidia tethys* (Townes)

Table 2 summarizes the present knowledge of Chironomids in Italy. 76 species new to the Italian fauna and 45 dubious determinations that require further study and additional material emphasize that there is still room for knowledge about Italian Chironomids to progress.

Most species are widely spread in the Palearctic region, some have more restricted areas of distribution. This is due to their ecology more than to zoogeographical reasons. Cold-stenothermal species are restricted to highlands (most Diamesinae and many Orthocladiinae): most of these species are widespread in the Alps (Region 4 in Fittkau & Reiss 1978), many are also present in cold countries in Northern-Europe (Fittkau & Reiss 1978). Many species found in the Alps are not present in cold waters in the Apennines, but this may be because of insufficient sampling. A lack of glaciers and of very cold water in the Apennines might be other reasons.

Three species (*Syndiamesa nigra, Tokunagaia tonollii* and *Stilocladius montanus*) were found on the southern side of the Italian Alps, but not on the northern side. *S. montanus* is also present in the Apennines (Rossaro 1984). This supports the existence of cold-stenothermal species with an endemic distribution in the Alps or with a wider southern distribution, as there are known to be for other species in the Mediterranean area. For example, *Diamesa lavillei* and *D. thomasi* are known from the Pyrenees only (Serra-Tosio 1973), whereas *D. veletensis* was previously known only in the Sierra Nevada

(Spain) but was then captured in the Atlas mountains (Morocco) and in Mongolia, suggesting it has a wider distribution in southern and oriental parts of the Palearctic Region (SERRA-TOSIO 1983). The capture of another species of *Stilocladius (S. clinopecten* Saether) in the southeastern United States favours a Gondwanian origin for this genus (SAETHER 1983). The southern side of the Alps has large extensions of Gondwanian origin, so this hypothesis has good geological support.

Table 2: Summary of the present information about Chironomids in Italy:
+ taxa well identified, deposited in the author's collection
= species new to the Italian fauna
£ species belonging to the Italian fauna according to the literature but not present in the author's collection
total: sum of +, =, £
* species only tentatively identified because of a lack of adult males, ill-preserved material or species belonging to genera that require revision

	+	=	£	total	*
Tanypodinae	21	8	13	42	3
Diamesinae	21	2	0	23	4
Prodiamesinae	3	0	0	3	1
Orthocladiinae	82	47	14	143	27
Tanytarsini	26	11	22	59	1
Pseudochironomini	0	0	0	0	1
Chironomini	61	8	20	89	8
Total	214	76	69	359	45

REISS (1968) did not find any differences in Chironomid species composition in lakes on the northern and southern sides of the Alps, suggesting that the Alps are not a zoogeographical barrier for Chironomids. This does not contradict our findings. Indeed Chironomid species from the upper reaches of the mountains and their springs (BRUNDIN 1966) have more chance of showing an endemic distribution than species from lakes. In any case the number of endemic species seems to be very low.

The percentages of Mediterranean, Afro- and Panpaleotropical species in Italy are also of interest. The Chironomids from the Mediterranean area have been studied only recently, but rather intensively in recent years. According to REISS (1977), the Mediterranean fauna contains 22.7 % of Palearctic Mediterranean species and about 9 % of Ethiopian species. PRAT (1979, 1980), MOUBAYED & LAVILLE (1983) and REISS (1985, 1986) give lists of species from single countries within the Mediterranean area. There are low percentages of endemic Mediterranean species and lower percentages of Afro- and Panpaleotropical species in most cases, with a dominance of Palearctic species. Even lower percentages are known in Italy. Two species with a Panpaleotropical distribution (REISS 1985, 1986) that extend their presence to the Mediterranean region are restricted to southern areas of Italy. These are *Chironomus calipterus,* found in Sardinia, and *Dicrotendipes peringueyanus* in Sicily. Another species with a Panpaleotropical distribution, *Polypedilum nubifer,* is probably present in northern Italy, in the Po and Adige rivers (NOCENTINI, 1985), but unfortunately only larvae are available and species determination is uncertain. On the other hand, some species with an Afrotropical distribution are definitely present in northern Italy: they are *Rheotanytarsus montanus, Polypedilum aegyptium* and *Stenochironomus spatuliger.* Two other Afrotropical species known to occur in Italy are *Pseudosmittia subtrilobata* from Sardinia and *Tanytarsus horni* from Sicily (REISS 1977). *R. montanus* was collected from the Ticino (Lombardia) and the Potenza (Marche) (stations 3 and 10, Figure 1). It fits all the details in the description of LEHMANN (1979) except for the A. R., which is larger (= 0.8). It does not fit the descriptions of the other European species. *P. aegyptium* comes from the Po river, *S. spatuliger* from the Mantova lakes (Figure 1). The halobiont species *Haliella noctivaga* and *Halocladius stagnorum* were

included in the Mediterranean faunal component by Reiss (1977). Other endemic Mediterranean species captured in Italy are: *Paratanytarsus mediterraneus, Tanytarsus maroccanus, Polypedilum açifer* and *Harnischia angularis.*

It is interesting to note that five species reported as Nearctic have been found in Italy: *Rheopelopia acra, Euryhapsis annuliventris, Nanocladius spiniplenus, Parametriocnemus eoclivus* and *Saetheria* sp. 1 Jackson. According to this, Holarctic distribution must be assigned to them.

In any case, the lack of knowledge or uncertain information for large areas suggests caution in drawing conclusions about geographical distribution. Very often new findings extend the distribution area of species very greatly. For example, *T. tonollii* was recently captured in Norway (Tuiskunen pers. comm.). More extensive knowledge of the Chironomids in Italy is very desiderable, because of its strategic position between the Palearctic and Afrotropical regions.

There is very scanty information for central and southern Italy at present. More detailed knowledge about these areas will probably raise the number of Mediterranean and Afrotropical species. Another very interesting field is the faunal composition in the cold waters on the southern side of the Alps and in the Apennines: it is important to confirm or refute the existence of cold-stenothermal Chironomid species with a southern distribution.

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Emergence patterns of chironomids in Keszthely-basin of Lake Balaton (Hungary)

(Diptera, Chironomidae)

By György Dévai

Abstract

The author tries to give a general idea of the characteristic features and patterns of the emergence of chironomids relying upon two series of examinations of a long period between March 11 and October 18, 1980 as well as between March 15 and August 31, 1983, which were performed on the Keszthely shoreline of the biggest shallow lake of Europe, Lake Balaton. Relying upon the comparative analysis and computer processing of the data set of the daily observations as well as that of 53 and 147 samples of pupal exuviae collected in 1980 and 1983, respectively, the author presents the characteristic emergence types and states the main emergence periods. He analyses in detail the essential changes which occurred in the taxonomic composition of samples of pupal exuviae between 1980 and 1983.

Introduction

One of the decisive and obviously the most spectacular moments of the life of chironomids is their emergence. Moreover, this process has an outstanding significance also in the settling dynamics and matter circulation of water bodies (Dévai et al. 1979, Dévai 1980a, 1980b). Thus it is understandable that the rough and regular interventions performed in the environs of water bodies as e. g. mosquito extermination by aeroplane or helicopter inevitably raise the question how the chironomids are en dangered.

In the case of Lake Balaton there was another important viewpoint to be said for the fact that mosquito extermination should follow the emergence dynamics and swarming peculiarities of chironomids. It is well-known that land-fauna exterminated in consequence of mosquito extermination is relatively soon supplemented from the neighbouring regions due to the so-called vacuum-effect (Sáringer et al. 1984). However, at insects flying out of water, especially in the case if extermination covers the predominant part of the shoreline (as e. g. in the case of Lake Balaton as well), the decrease of individual number can be so drastic among the animals generally assembling here that the population sustains permanent loss through it and the standing mass can decrease to 10 or 20 % of the original number. This condition of risk especially exists in the case of Lake Balaton, the peculiar chironomid fauna of which rests first of all on self-revival since the fauna practically cannot or can only be slightly supplemented from the neighbouring regions failing water bodies of a similar type and size.

Accordingly it was justified from several viewpoints to investigate the emergence dynamics of the chironomid fauna of Lake Balaton thoroughly. In my present paper I wish to give a survey about the results of our investigations of emergence performed in 1980 and 1983.

According to the reports of the majority of papers (see e. g. Palmén 1958, 1962, Danks 1971, Stahl 1975, Lindegaard & Jónasson 1979, Butler 1980) the emergence of chironomid adults from the pupal-exuviae and at the same time their emergence from the water bodies occur in periods characteristic of

the different species and they do not show more than little temporal shift in the subsequent years. The emergence can be generally observed once or maximum two or three times a year and on these occasions the animals emerge in great mass. At the same time certain experiences in the field (e. g. Hein & Schmulbach 1972, Jonsson & Sandlund 1975, Ali et al. 1983, 1985) or laboratory experiments (e. g. Danks 1978) refer to the fact that the emergence period of certain species can be significantly long-drawn and during this long period several generations can emerge. According to the data up to now the emergence was synchronized with one of the abiotic environmental factors or the joint effect of two of them. Such factors can be e. g. water temperature, light conditions, air pressure or ebb and flow (Lenz 1962, Palmén 1962, Danks 1971, 1978, Hein & Schmulbach 1972, Hashimoto 1975, Heimbach 1978, Bagge et al. 1980).

Material and Method

Our examinations were performed on the biggest shallow lake of Central Europe, Lake Balaton (its detailed characterization see in papers by Bíró 1984, and Dévai et al. 1984). Our main sample area out of the regions of the lake with different water qualities was the Keszthely-basin mostly endangered by the accelerated eutrophication of recent years.

A series of observations during a period of 236 days was performed on the shoreline of Lake Balaton at Keszthely in 1980 in order to examine the emergence in a pragmatical way. The regular surveys were performed on the pier of the harbour of Keszthely each day from March 11 to October 28. This point of the shoreline was proved to be convenient from several viewpoints: the pier projects far into the open water of the lake (to a distance of 200 m), at its end the water depth is already near the average (about 2 m) and no reeds of a large extension can be found at the pier (in a district of approximately 500 m). In this way this site of observation and sampling was suitable to reflect satisfactorily the conditions of the open water of almost the whole Keszthely-basin. The second series of examinations of 170 days was performed in the same place from March 15 to August 31, 1983.

Relying upon our earlier experiences collections of pupal exuviae proved to be the most suitable for establishing the frequency and intensity of emergence. Therefore parallel with the observations on the occasions of great emergences we also took samples of pupal exuviae from the floating material accumulated along the pier. From this viewpoint the choice of the sample area was very favourable since the peculiar flow conditions of the Keszthely-basin (Györke et al. 1980) ensured with the greatest possibility that the pupal exuviae material characteristic of the total water surface could drift together.

For the sampling of pupal exuviae we used a sack-like "skimming-net" of our planning. The samples were preserved in 70 % ethylalcohol in of 50–200 ml cubic capacity depending on the quantity of the collected material. The pupal exuviae were selected and counted by means of a stereomicroscope of Technival type and of Zeiss (GDR) make. In order to unify the processing permanent preparations were made from the pupal exuviae of different type for an identifying and comparative collection (Schlee 1966).

On the occasions of great emergences several hundred or sometimes several thousand pupal exuviae could often be found in the samples. For their processing the application of the following method seemed to be expedient. After a careful shaking a certain number of pupal exuviae was taken out of the sample with Leonhard forceps, the genera occurring in it were determined and the number of their pupal exuviae was in the percentage of all the counted ones. We had only two obligations regarding the quantity taken out of the sample. One of them was that the number of examined exuviae should be above 100 and the other was that any additional pieces taken out were also counted. The first obligation ensured that the obtained quantities should reflect roughly the proportions in the whole sample. And by counting all the pupal exuviae taken out we avoided the mistake of conscious choice.

Relying upon our literary studies and our field experiences we chose factors from the system of factors being able to influence the emergence and their detailed analysis was expected to result in the knowledge of phenomena and processes producing and synchronizing the emergence. The factors investigated were the following: the real daily mean value, maximum and minimum of the air temperature; the sum of the daily radiation and the duration of sunshine; the daily most frequent direction of wind; the real daily most frequent direction of wind; the real daily mean value of the wind speed as well as the extent of its daily fluctuation; the real daily mean value of the air pressure and the extent of its fluctuation; the daily mean value of the air humidity; the daily sums of the evaporation and precipitation; the value of the morning and evening water temperature; the strength of waviness in the morning and in

the evening; the values of the air temperature, wind direction, wind speed and air humidity measured at 7 p. m. These factors were measured partly by ourselves and partly the data of the Keszthely Synoptic Station of the National Meteorological Service as well as those of the Research Institute of the Atmosphere Physics were utilized by us, for the conveyance of which data we express our thanks.

The nearly 10 thousands data were fixed on a magnetic band and processed by the Robotron (GDR) computer of R 55 M type of the Computing Centre of the L. Kossuth University. The evaluation of the data was performed by means of the hierarchical cluster analysis programme functioning on the basis of Euclidean distances as well as the stepwise discriminance analysis programme of BMDP. In order to increase the certainty of the processing, we took notice first of all of the great emergence cases (indicated with double or triple motive on Figure 1) or we drew into the processing only those of the emergences of less intensity (indicated with one motive) which could be identified regionally or could be delimited from one another temporarily with proper certainty.

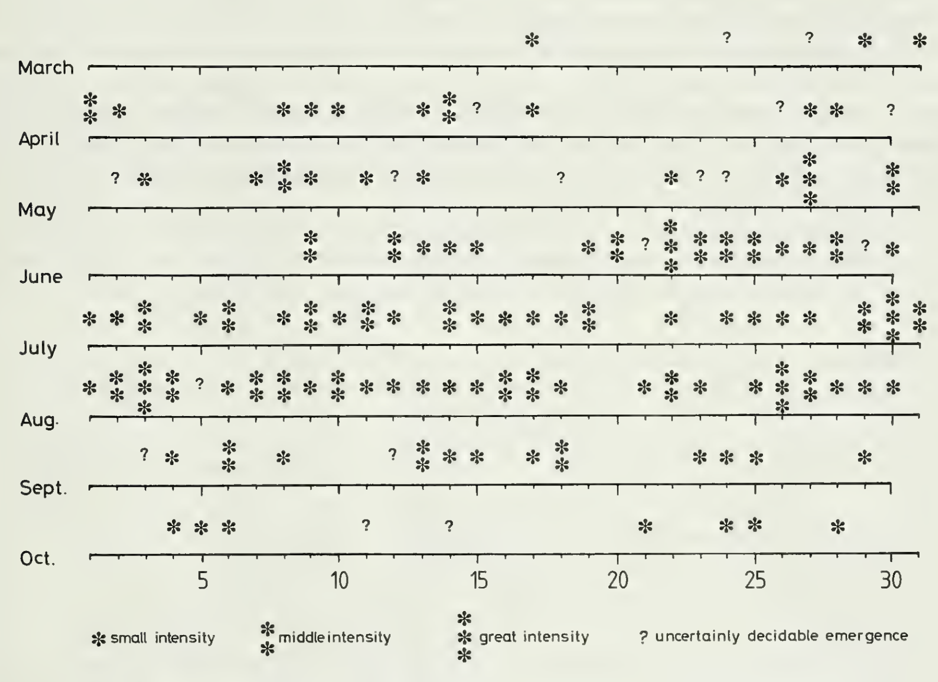


Fig. 1. Emergences in 1980 and their intensities on the basis of pupal exuviae collections.

Results and Discussion

Although the processing procedure detailed above, could not bring absolutely exact results, it made the present opinions about the emergence dynamics and the change in taxonomic composition of the chironomids of Lake Balaton more exact even in its first approach to a great extent. On the basis of our field experiences and the results of our evaluation we can draw the following main statements.

The emergence dynamics of the chironomids in Lake Balaton is almost unprecedented considering both the long-drawn period of the emergence and the frequency of the emergences. According to our observations in 1980 the period of emergence lasted from the middle of March until the end of October (Fig. 1). From May to September emergence was observed on an average every second day, it was even of middle intensity every fifth day. The main emergence periods were May 26—27, June 20—25, July 29-August 4 and August 25—27.

In 1983 the emergence was considered to be even more uniform, disregarding some small interruptions it lasted almost continuously. Emergence cases of great intensity were observed on 5 occasions: April 11–18, June 25-July 3, July 30-August 2, August 21–26 and September 12–18. Regarding the mass of the emergence the first emergence case was specially striking. It is definitely worth mentioning that during nearly the whole month of May emergence of medium strength went on and no doubt it was entirely at least as significant as any other very strong emergence lasting for a short time. As a result of our observations performed on the whole territory of the Lake Balaton in 1980–1985 we can state that significant differences can be experienced in the frequency and strength of the small emergence cases along the total shoreline of Lake Balaton. However, according to the experiences up to now the great emergence cases are never limited to a smaller region or any basin but they go on simultaneously on the whole surface of the lake.

Comparing the results of the observations performed in 1980 and 1983 it can be seen that emergence cases became definitely more frequent by 1983. It manifested itself in not only the number but also the strength of the emergence cases. The most conspicuous sign of it was that mass emergence cases also increased, namely with two peaks in the middle of April and in the middle of September. In the same periods of 1980 we observed only medium emergence. The change can be obviously explained with the significant increase of the food supply and the change in the species composition (Dévai et al. 1984). The earlier peak at the end of May – due to similar causes – changed into an emergence period of middle strength lasting almost continuously in May, which well can be brought into correlations with the results of larval investigations (Dévai 1985). However, the three great summer emergence

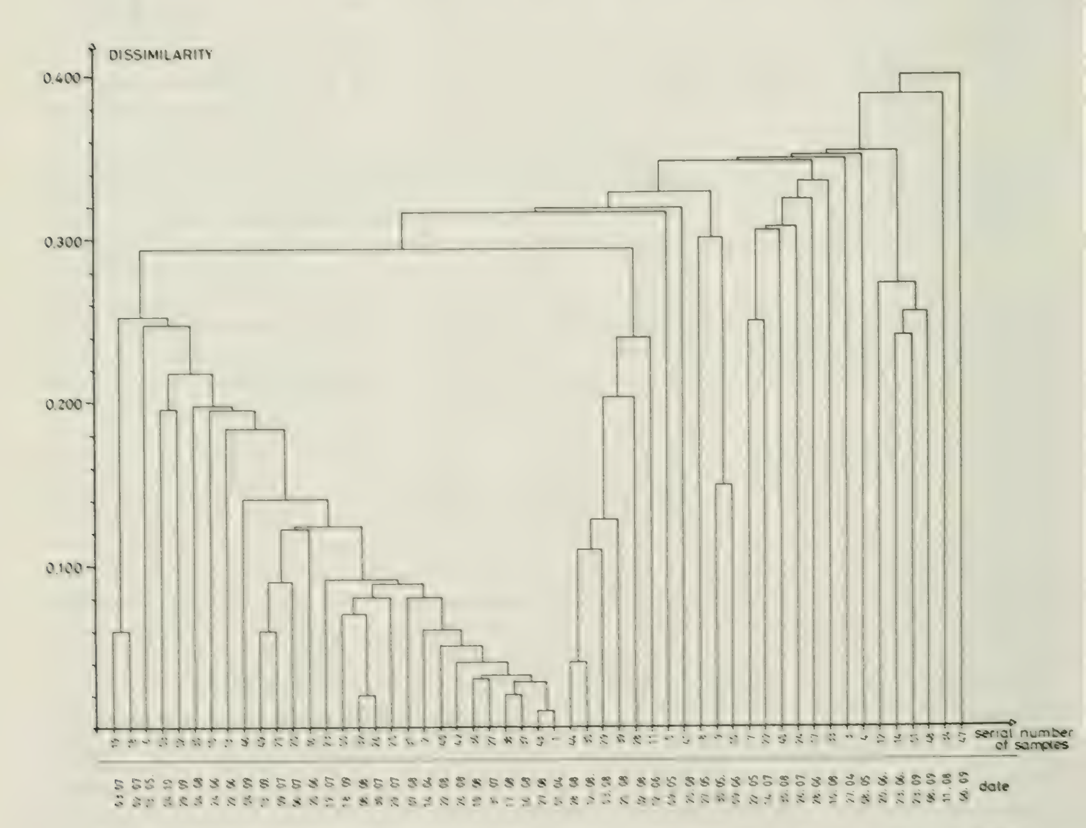


Fig. 2. Dendrogram of pupal exuviae samples collected on occasions of important emergences in 1980.

periods remained the same, disregarding a shift of some days due to the actual change in weather conditions.

The field experiences showed that mass emergences mainly occurred at sudden change of temperature and they seemed to be characterized roughly with the changes of meteorological factors. This hypothesis was supported by the observations that mass emergence often followed the red storm signals, however, they did not occur if wave activity was permanently strong and especially if combing waves were observed.

Accordingly, when making an effort to understand the effects inducing or at least promoting the emergence we analysed the examined meteorological factors successively and compared them at first separately and later in different combinations to the emergence pattern. Naturally, in the latter case we took into consideration that between the factual occurrence and the observation of emergence there were significant temporal differences, depending upon the actual weather conditions (first of all wind conditions) amounted to at least 2–3 hours, generally 6–10 hours but sometimes even 12–24 hours.

We did not get an unambiguous and comprehensive relationship in any case, not even the discriminance analyses brought satisfactory results. We only succeeded in establishing that groupings made on the basis of empirical facts and the discriminance function may correspond each other in an acceptable way (in approximately 70–75 % of all the cases) if we consider the values of the daily radiation and the average air temperature or those of the water temperature in the morning. However, this relationship weakens if we take notice that for example the emergence of the *Chironomus balatonicus*, the most abundant and frequent chironomid species occurred at the values of the water temperature between 10–28°C alike.

Relying upon all these findings we drew the conclusion that in the future we have to put the main stress on the examination of the relationship of emergence and front situations since the separate study of individual meteorological factors does not reflect properly the change in the weather conditions caused by the different meteorological fronts (Kiss 1959). At the same time the results obtained called our attention to the fact that in the peculiar weather conditions of Carpathian basin that are characteristic of the environs of Lake Balaton, it is hardly probable that the start or stop of the emergence can be attributed to only one or 2–3 factors as well. It can be rather postulated that the emergence dynamics of the chironomids do not depend upon the change of a certain meteorological element but upon the joint effect of several, often a series of factors, they can be practically interpreted as the resultant of them; naturally with the exception of extreme cases. However, by means of demonstrating the regularities still observable in the emergences as well as elucidating their causes we see the possibility of predicting mass emergences both in region and in time and so of successfully promoting the prevention of the permanent damage of fauna.

At the samples of 1980 in the percentage distribution of exuviae belonging to different genera two main groups could be separated on the basis of the results of both comparative analyses and cluster analysis (Fig. 2). In one of them the *Chironomus* exuviae dominated, their proportion was mainly above 70 % but it always exceeded 50 %, except one sample. Four separate subgroups occurred within this group. It was characteristic of the first subgroup that *Chironomus* exuviae represented 85–98 % of all the exuviae (samples 1–31). In the other samples the remaining proportion (15–55 %) in addition to the *Chironomus* exuviae was represented by mainly *Procladius* exuviae in the second group (samples 25–50), by *Tanypus* exuviae in the third group (samples 16–49) and by *Cricotopus* exuviae and those belonging to other Chironominae taxa in the fourth group (samples 46–19). The samples being present within this group constitute the most significant proportion, approximately 53 % of all the examined samples.

The other great group shows a much more colourful picture than the previous one and far more subgroups could be separated within it mainly relying upon the exuviae belonging to genera occurring in greater proportions. On such a basis four subgroups could be recognised with more or less certainty.

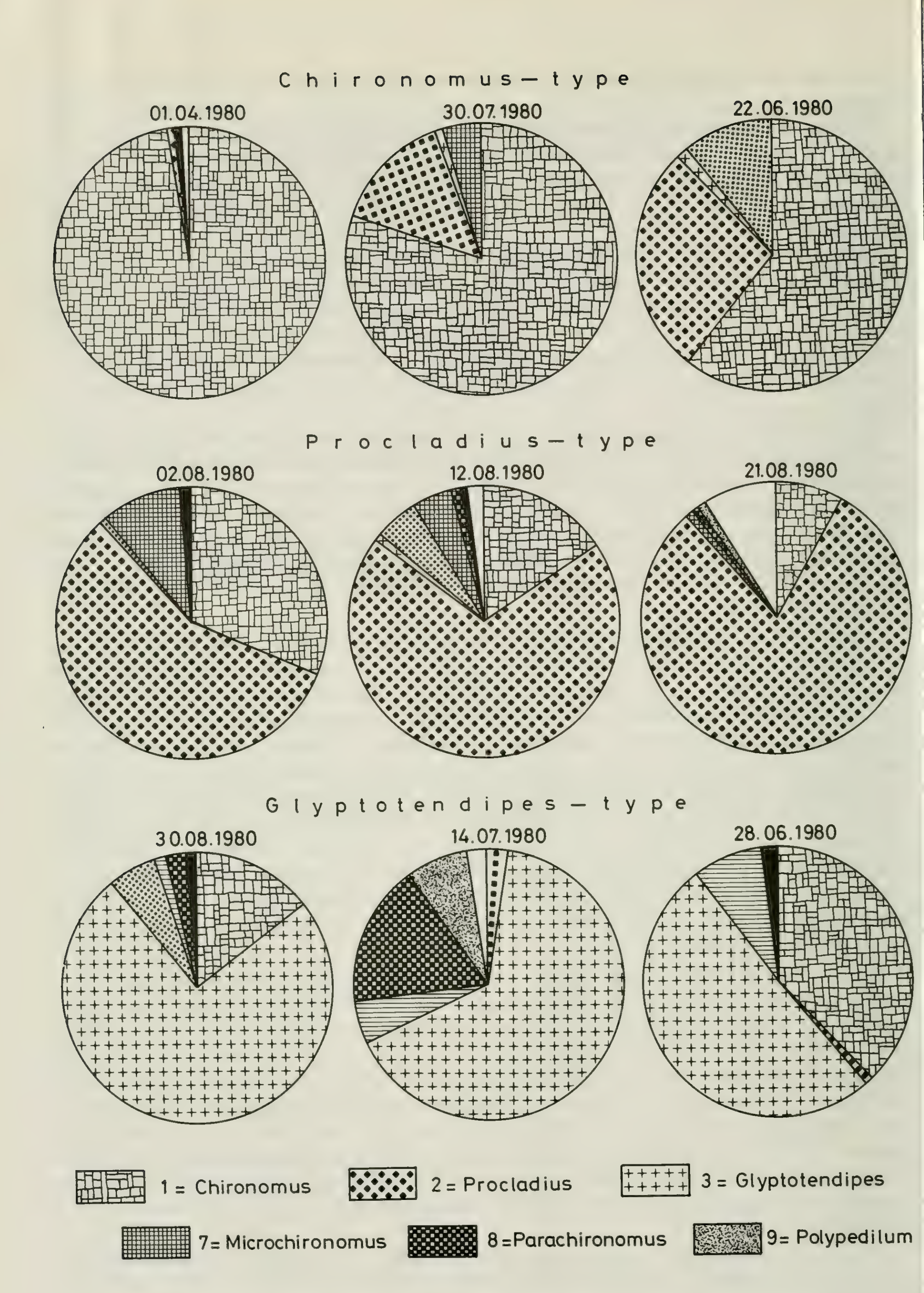
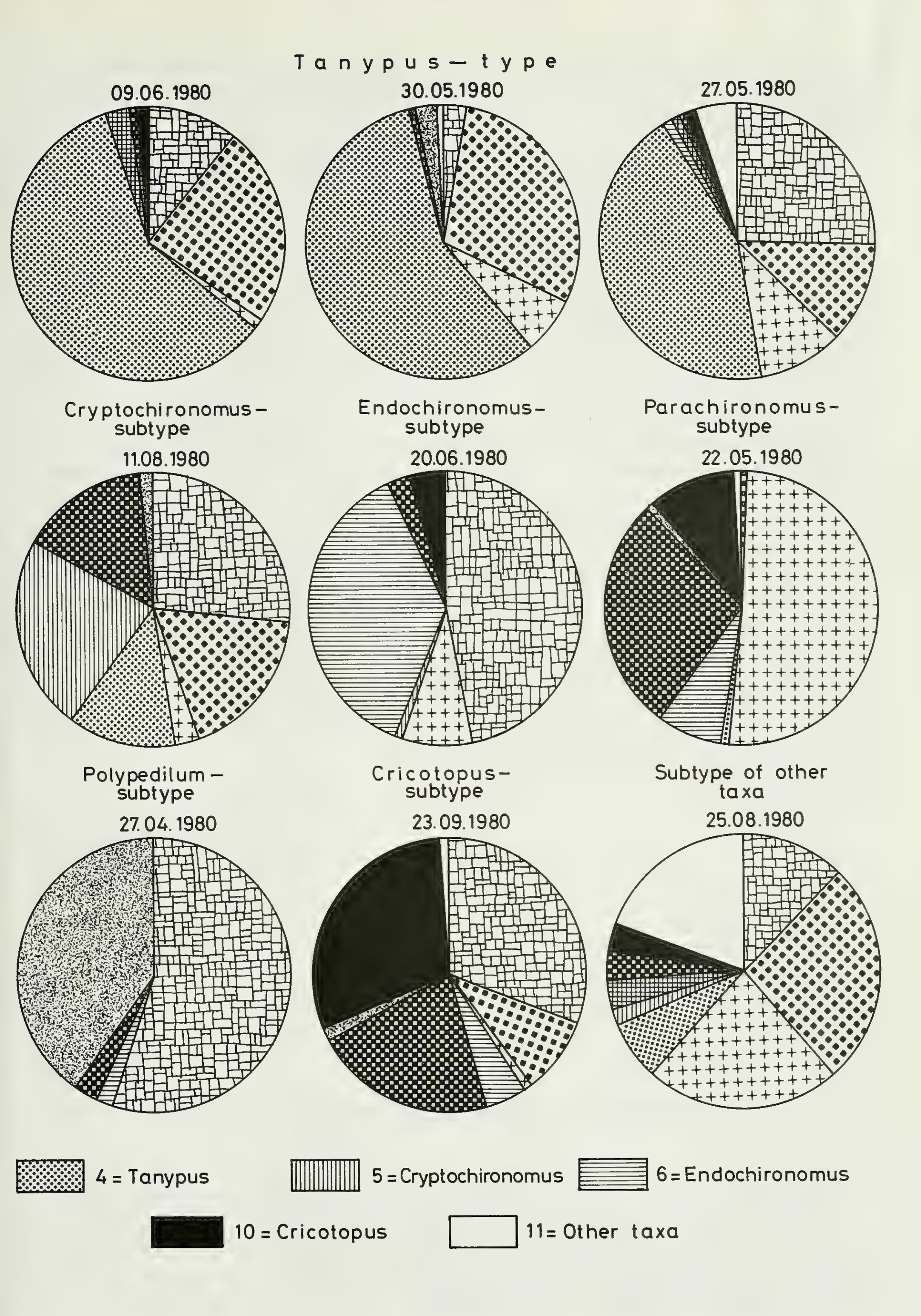


Fig. 3. Different types of emergence patterns in 1980 on the basis of pupal exuviae collections.



Tanypus — type
09.06.1980
30.05.1980
27.05.1980
Cryptochironomus – subtype
Endochironomus – subtype
Parachironomus – subtype
11.08.1980
20.06.1980
22.05.1980
Polypedilum – subtype
Cricotopus – subtype
Subtype of other taxa
27.04.1980
23.09.1980
25.08.1980
4 = Tanypus
5 = Cryptochironomus
6 = Endochironomus
10 = Cricotopus
11 = Other taxa

In the first one the relatively high percentage (between 43—81 %) of *Procladius* exuviae (samples 11—44), in the second one that of *Tanypus* exuviae (samples 8—10), in the third one that of *Glyptotendipes* exuviae (samples 7—33) and the smaller quantity of *Chironomus* exuviae (in the majority of cases under 25 %) in all the three could be considered as a separative feature. These subgroups represent 11 %, 6 % and 11 % of all the examined samples, respectively. The other samples drawn in the fourth group are of very varied composition. In fact this constitutes an independent subgroup because of its separation from the former ones. The samples grouped here in addition to the *Chironomus* exuviae of the proportion mainly above 30 % either contain exuviae that belong to some genera not mentioned in the foregoing in a proportion of approximately 30 % or their composition according to genera shows a very varied picture. These cases constitute about 19 % of all the examined samples. The circle diagrams shown in Figure 3 illustrate some of the typical cases of these emergence patterns.

The summarized evaluation of the frequency of occurrence of pupal exuviae belonging to genera that were detectable in a significant amount was performed in two different ways from the data of the 53 selected samples. On the one hand we examined in what proportion the pupal exuviae were present by genera compared to the total amount of counted pupal exuviae. For the genus *Chironomus* this value was 51 %, for *Procladius* it was 15 %, for *Glyptotendipes* it was 11 % and for *Tanypus* it was 7 % i. e. these genera constituted 84 % of all the pupal exuviae. Altogether only 16 % was the proportion of the other genera under the frequency limit of 5 % *(Cryptochironomus, Endochironomus, Microchironomus, Parachironomus, Polypedilum, Cricotopus).*

Somewhat different picture was obtained if the frequency of occurrence was evaluated only on the basis of presence and absence independently of quantitative results. Although the order of the first four species did not change since among the pupal exuviae found in the samples *Chironomus* occurred in 96 % of the cases, *Procladius* occurred in 79 %, *Glyptotendipes* occurred in 75 % and *Tanypus* occurred in 60 % of all cases. However, in this summarizing the presence of pupal exuviae belonging to other genera was also significant since they occurred in 96 % of the samples.

An opportunity presented itself for an even more comprehensive evaluation by combining the two procedures i. e. by establishing the presence or absence above or under certain quantitative limits. The following results were achieved by this method:

The percentage frequency of occurrence	At A	B	C genera (in %)	D	E
In case of a quantity above 75 %	32	4	0	0	0
In case of a quantity above 50 %	53	11	9	4	4
In case of a quantity above 25 %	76	21	13	8	28
In case of a quantity above 10 %	87	36	25	25	47
In case of a quantity above 5 %	92	49	34	34	68
In case of a quantity under 5 %	4	30	41	26	28
The frequency of the cases when the pupal exuviae belonging to the given genus did not occur in the sample	4	21	25	40	4

(A =*Chironomus,* B =*Procladius,* C = *Glyptotendipes,* D = *Tanypus,* E = Other taxa)

It can be seen from the data that already in 1980 the *Chironomus* exuviae could be considered as most significant not only regarding the number of occasions but also quantitatively since they proved to be absolute dominant in more than half of the examined cases and they were the determinants of type (in an amount of above 25 %) in more than three-quarters of them. The *Procladius* exuviae could be considered to a much less extent but still unambiguously characteristic as regards both the frequency of occurrence and the quantitative conditions.

We got pictures fairly similar to each other with the exuviae belonging to the *Glyptotendipes* and *Tanypus* genera, which occurred as the determinants of type in a part of the cases and as absolute dominants in some cases. However, all together they did not prove to be more significant than *Procladius* itself. The difference between them was first of all that the *Glyptotendipes* exuviae were present more times in great (above 50 and 25 %) and small (under 5 %) amounts than *Tanypus* exuviae, however, the latter were more frequently absent in the samples.

The total amount of exuviae belonging to nearly 8—10 other genera could not be considered as negligible in spite of the fact that they have individually never proved to be absolute dominants, they occurred as the determinants of type in only 6 cases even the number of the cases when they were separately detectable in an amount above 10 % was only 18.

At last, relying upon the data of 1980 we wished to see whether the differences in the distribution according to genera corresponded to any temporal emergence pattern. Unfortunately relying upon the processed samples, satisfactory answer cannot be given to this question. We could state with a more or less certainty all in all that *Chironomus* dominance could be demonstrated continuously while a proportion exceeding the average was observed for *Procladius* exuviae first of all from the end of May to the middle of June and in August, for *Tanypus* exuviae mainly in June and in the first half of September and for *Glyptotendipes* exuviae in the middle of May, at the end and beginning of June as well as after that on several occasions during certain shorter periods (e. g. about July 14, 26, August 10, 25, 30, September 8). The samples in which the representatives of the other genera were present in a significant amount, sporadically originated from the whole emergence period but the samples collected in May and September seem to be at least relatively somewhat more frequent among them.

If we compare the data of the series of samples from 1983 to the results of 1980, the following important differences come out. In the percentage summarizing according to the amount of pupal exuviae the proportion of *Chironomus* exuviae strikingly increased (by 16 %) and that of the *Procladius, Glyptotendipes* and *Tanypus* exuviae significantly decreased (by 4—6 %). The proportion of the exuviae belonging to other genera did not change significantly (only decreased by 2 %). These shifts of the proportion totally coincide with the experiences of larval examinations (Dévai 1985).

The examination of the frequency of occurrence on the basis of presence and absence brought somewhat different results compared to the foregoing. A decrease was experienced only for *Glyptotendipes* exuviae and it was only slight (altogether 7 %). With the exception of that a rise could be established in the case of all the genera.

The following data obtained by combining these two methods let us conclude to the real relations most of all.

The percentage frequency of occurrence	A	B	At C genera (in %)	D	E
In case of an amount above 75 %	29	0	0	0	0
In case of an amount above 50 %	90	0	0	0	0
In case of an amount above 25 %	100	1	1	0	7
In case of an amount above 10 %	100	57	10	5	65
In case of an amount above 5 %	100	88	30	28	90
In case of an amount under 5 %	0	11	38	54	10
The frequency of the cases when the pupal exuviae belonging to a given genus did not occur in the sample	0	1	32	18	0

(A = *Chironomus*, B = *Procladius*, C = *Glyptotendipes*, D = *Tanypus*, E = Other taxa)

These results unambiguously show the almost absolute dominance of *Chironomus* exuviae and the significant depression, of the proportion of all other genera. For example it is characteristic that in

1983 in the case of the Keszthely basin we did not find an example of the *Procladius* dominance reminding of the picture of the original fauna in Lake Balaton and still detectable on some occasions in 1980. The tendencies recognized here support our ideas which we formed of the transformation of the sediment-dwelling chironomid fauna of Lake Balaton and of the cases and trends of the resulted changes (Dévai 1985).

When we wanted to determine the emergence periods for the quantitatively significant genera on the basis of the samples taken continuously in 1983, maybe we got into an even more difficult situation than in the case of sporadically taken samples of 1980. Namely these data really give evidence of the fact that emergence lasts almost continuously for the representatives of almost all the genera. Although the strength of emergence changes and it can decrease on several occasions for periods of some days or at most one or two weeks, however, it only rarely ceases entirely on these dates.

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Corynoneura brundini spec. nov. Ein Beitrag zur Systematik der Gattung Corynoneura

(Diptera, Chironomidae)

Von **Mauri** und **Elina Hirvenoja**

Zusammenfassung

Für *Corynoneura scutellata*, der Typusart der Gattung *Corynoneura* Winn. wird ein Neotypus designiert und die systematische Stellung der Art geklärt. Arten der Untergattungen *Corynoneura* s. str. und *Paracorynoneura* im Sinne von Goetghebuer (1939) werden in die *Corynoneura scutellata*-, *C. edwardsi*- und *C. carriana*-Gruppen eingeordnet. *Corynoneura brundini* spec. nov. ist nächstverwandt mit *Corynoneura edwardsi* Brund.

Einführung

In der älteren Literatur findet man eine Reihe von Arten und auch höheren Taxa, die in den Verwandtschaftskreis der Gattung *Corynoneura* gehören. Bis heute liegt keine umfassende Revision der europäischen Arten vor, so daß eine Artbestimmung vielfach nur mit Vorbehalt möglich ist. In der Limnofauna Europaea sind von FITTKAU und REISS (1978) 28 Artnamen aufgeführt. Es handelt sich um jene „Arten", die, meist beschrieben von Kieffer, schon im „LINDNER" von GOETGHEBUER (1939) aufgelistet worden sind.

Die taxonomischen Probleme mit der Gattung *Corynoneura* beginnen bereits mit der Originalbeschreibung der Gattung von WINNERTZ (1846: 12):

„Fam. Tip. culiciformes. Antennae prorectae, filiformes; maris novem-articulatae, plumosae, inferioribus octo ovatis, ultimo majore, clavato, apice pilis coronato; feminae quinque-articulatae, pilosae, inferioribus quatuor ovatix, ultimo eongato, pilis brevioribus coronato quam maris. Palpi incurvi, 4-articulati; articulo ultimo elongato. Oculi subrotundi, intus paullulum emarginati. Ocelli nulli. Alae lanceolatae, nudae, defelexae. Costa brevissima, in clavae formam dilatata; maris circiter ad quartam partem, feminae ad medium marginis antici pertinens."

Aus der ausführlichen illustrierten Diagnose auf Deutsch geht deutlich hervor, daß es sich um eine Chironomide handelt, die eine sehr charakteristische 10gliedrige Antenne (Pedicellus mitgezählt) mit einer großen und ungewöhnlichen apikalen „Rosette" besitzt. Weiter ist zu ersehen, daß es sich bei der Gattungsdiagnose eindeutig um die Art *Corynoneura minuta* Winnertz (1846: 13) handelt. EDWARDS (1929: 367–368) hat das einzige Männchen, das der Originalbeschreibung von *C. minuta* zu Grunde lag, gesehen. Er bestätigt die Anzahl der Antennenglieder, wie sie bei der Originalbeschreibung gegeben ist. Die Abbildungen bei Winnertz sind außerdem so gut, daß die Art leicht erkannt werden kann. Im Naturhistorischen Museum in Wien befindet sich ein als Typus markiertes Weibchen, das die Identität mit dieser Art bestätigt.

COQUILLETT (1910: 528) faßte nach den damals eingeführten nomenklatorischen Regeln *Corynoneura scutellata* als Typus auf, da sie die erstaufgeführte, wenn auch ganz ungenügend beschriebene Art in der Arbeit von WINNERTZ (1846: 13) ist. WINNERTZ erwähnt u. a., daß die Rosette von *C. scutellata* kurz ist.

Die dritte *Corynoneura*-Art, *C. lemnae* beschrieb SCHINER (in FRAUENFELD 1866: 974). Frauenfeld selbst ergänzt die Beschreibung dieser Art mit Angaben über deren Ökologie und Metamorphosestadien. GOETGHEBUER (1939: 7) sieht *C. lemnae* als ein *nomen dubium* an. *C. lemnae* ist aber auf Grund des Originalmaterials (vgl. weiter unten) gut definierbar. SCHINER versucht bei seiner Beschreibung von *C. lemnae* diese Art mit *C. scutellata* zu vergleichen. Seine Auffassung von *C. scutellata* ist belegt mit einem Weibchen seiner Sammlung, heute aufbewahrt im Naturhistorischen Museum in Wien. Dieses Exemplar ist jedoch ein Weibchen von *C. coronata* Edw. einer Art mit einer deutlichen Antennenrosette.

Von KIEFFER (1906: 328) wurde das ♂ einer weiteren Art, *C. bitensis*, beschrieben. Nach der damaligen Vorstellung von Kieffer können die Antennen der Männchen von *Corynoneura* 10- oder 11gliedrig (wie bei *C. bitensis)* sein, wobei das letzte Glied etwa ebenso lang ist, wie die vorhergegangenen zusammen. Die Beschreibung bei Kieffer ist ungenügend. Da aber das 2. Palpenglied beim Männchen von *C. bitensis* länger als breit sein soll, kann es sich auch um eine Art der später beschriebenen Gattung *Thienemanniella* Kieff. handeln. Kieffer vergleicht die Art *bitensis* mit *C. celeripes* WINNERTZ (1852).

Kieffers Vorstellung von *C. celeripes* wurde von ihm (1899: 825–27) sehr gut begründet. Die illustrierte Beschreibung zeigt eindeutig eine Art, die in die *C. scutellata*-Gruppe gehört, wie sie in der vorliegenden Arbeit definiert ist. Kieffer hatte jedoch eine falsche Zuordnung vorgenommen. Nach EDWARDS (1929: 367–368) besitzt *C. celeripes* eine 13gliedrige Antenne. Aus dem Text bei EDWARDS geht hervor, daß er Originalmaterial gesehen hat.

EDWARDS (1919: 226) beschrieb aus einer parthenogenetischen Population das Weibchen von *C. innupta* und später (1924: 188, 189 Fig. 11) auch das Männchen. *C. innupta* wurde von ihm (1929: 369) mit *C. scutellata* synonymisiert, obgleich *C. innupta* keine Antennenrosette hat. Es hat sich gezeigt, daß *C. innupta* und *C. lemnae* artidentisch sind (vgl. unten).

Das Fehlen der Antennenrosette bei gewissen Arten wurde von Edwards (1924: 188) diskutiert, als er den Bau der rosettenlosen Antenne von *C. celeripes* Winn. erwähnt und bezweifelt, daß Kieffer diese Art richtig verstanden hat. Als Edwards *C. innupta* beschrieb, erwähnt er, daß *C. innupta C. scutellata* ähnelt, aber daß die letzterwähnte Art, ihm unbekannt ist. Edwards hatte offenbar noch vor 1929 das Originalmaterial aller von Winnertz beschriebenen *Corynoneura*-Arten untersucht. Vermutlich ist dieses während des Entomologenkongresses in Bonn geschehen (Dr. P. Cranston in litt.), wenngleich Edwards nichts davon in seinen Veröffentlichungen erwähnt.

Der Auffassung Edwards folgend wurde seine Gruppe B mit *C. scutellata* als Untergattung *Corynoneura* s. str. von GOETGHEBUER (1939) verstanden. Die der Originalbeschreibung der Gattung zu Grunde liegende Art *C. minuta* müßte wegen der „Antennenrosette", die beide Geschlechter besitzen (ein Merkmal, das auch bei den bekannten Arten stets gegeben ist) in die Gruppe A von EDWARDS (1929: 368) oder zur Untergattung *Eucorynoneura* GOETGHEBUER (1939: 4) gestellt werden.

Die Schwierigkeiten, die die oben erwähnten Autoren in der Klassifizierung gehabt haben, werden auch dadurch deutlich, daß GOETGHEBUER (1939: 6) selbst *C. brevipennis* Goetgh. in *Corynoneura* s. str. gestellt hat. *C. brevipennis* ist eine Art mit Antennenrosette und weiteren Merkmalen der *Eucorynoneura*-Gruppe und sollte darum nicht zu *Corynoneura* s. str. im Sinne Goetghebuers gestellt werden. EDWARDS (1929: 369) seinerseits ordnet *C. fuscihalter* Edw. zu den Arten seiner Gruppe A, obgleich diese Art zum Verwandtschaftskreis von *Corynoneurella* Brund. gestellt werden muß, wie das erhaltene Originalexemplar erkennen läßt.

Unter dem Namen *C. scutellata* sind noch weitere Arten in der Literatur aufgefaßt worden. EDWARDS hat u. a. das Männchen von *C. gratias* Schlee *C. innupta* zugeordnet. PINDER (1978, 125 A) versteht unter *C. scutellata* die von Schlee beschriebene Art *C. gratias.* Eine Varietät von *C. scutellata* (sensu EDWARDS 1929: 369) wurde von BRUNDIN (1949: 833) als *C. edwardsi* beschrieben. SCHLEE (1968: 26) seinerseits grenzte *C. gratias* ab ohne zu wissen, welche Art *C. scutellata* im Sinne von Winnertz ist. Als *C. scutellata* wurde von SCHLEE (1968: 107) eine Art aufgefaßt, deren Hypopygium von LINDEBERG (1962: 8, sub *C. scutellata)* abgebildet worden ist. Zuvor hatten neben KIEFFER (1899, sub *C. celeripes)* und EDWARDS (1924, sub *C. innupta)* auch GOETGHEBUER (1932: 136, sub *C. scutellata)* von diesem Hypopyg-Typ mehr oder weniger gute Abbildungen gebracht. Wegen der Art *C. edwardsi* hatte LINDEBERG (1962) versucht, mit dem ihm vorliegenden finnischen Material die Art *C. scutellata* abzugrenzen. Später zeigte sich jedoch, daß die von ihm wegen ihres Hypopygiums als *C. scutellata* aufgefaßte Art *C. arctica* Kieff. war.

In Europa kommen wenigstens 3 Arten mit einem ähnlichen Stylus vor. Der Typus von *C. scutellata* ist jedoch ein Weibchen. SCHLEE (1968) konnte auf Grund genauerer Untersuchungen der Innenstrukturen des Hypopygiums 2 „*C. scutellata*-Arten" unterscheiden. Seine Auffassung von *C. scutellata* gewann er nicht zuletzt auf Grund von Exemplaren aus einem Torfstich, M_1, Riihimäki, Südfinnland, und aus dem Fluß Luiro, Sodankylä, Finnisch-Lappland, leg. HIRVENOJA (vgl. SCHLEE 1968: 107). Vermutlich befanden sich in dem unpräparierten, ihm zur Verfügung gestellten Material mehrere Arten. Dafür spricht, daß Schlee die abweichende Apikalborste von Ti/P_3 bei *C. scutellata* erwähnt, jedoch ein Hypopygium ohne Coxitlobus abbildet, das zu *C. arctica* gehört.

Die Tatsache, daß Edwards nicht den Typus von *C. scutellata* bis zur Art bestimmen konnte, ist bedauerlich, denn er war offensichtlich der letzte, dem Originalmaterial vorlag. Nach HORN & KAHLE (1935–1937: 305) war der größte Teil des *Corynoneura*-Materials 1881 an das Zoologische Museum in Bonn, weitere Exemplare auch an das Naturhistorische Museum von Wien, und nach Senckenberg, Frankfurt/Main, gekommen. Jener Teil der Insektensammlung mit den Chironomiden ist in Bonn während des 2. Weltkrieges verloren gegangen.

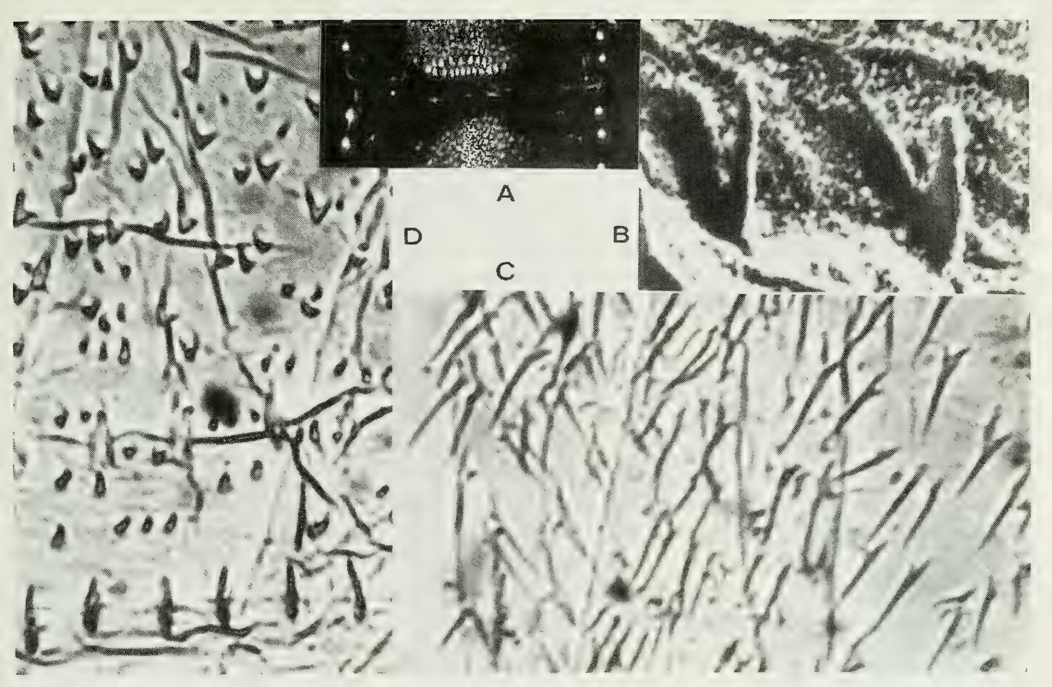


Fig. 1 *Corynoneura scutellata*. A Segmentgrenze der Puppenexuvie im Dunkelfeld mit intersegmentalen Dörnchen der Tergite und Sternite; B intersegmentale Dörnchen, REM-Aufnahme; C lange Spitzchen von Sternit 2; D Chagrinierung von Tergit 4.

Bemerkungen zur Morphologie von Corynoneura

Imago

Bei der Beurteilung der *Corynoneura*-Imago wird in diesem Zusammenhang von der Diagnose ausgegangen, die Brundin (1956: 172) gegeben hat. Brundin grenzt die Gattung im Sinne von Winnertz ab. Schlee (1968) faßt die Gattung *Corynoneurella* Brundin (1956: 171) als ein Synonym von *Corynoneura* auf. Es wird hier verzichtet, Stellung zu dieser Entscheidung zu nehmen, weil die Metamorphosestadien der in Frage kommenden Arten von *Corynonerella* nahezu unbekannt sind (Syn. ? *Bauseia* Kieffer 1922). Es ist nur die volle Metamorphose von *C. fittkaui* Schlee bekannt, die eventuell zur Gattung *Corynoneurella* gehören könnte. Diese Art zeigt Unterschiede gegenüber den nachstehend behandelten Arten, deren Wertung jedoch derzeit noch nicht möglich ist.

Zu den morphologischen Merkmalen, denen bisher noch nicht genügend Aufmerksamkeit geschenkt worden ist, gehört die Ausbildung des Clavus beim Flügel. Brundin (1956: 26) illustriert dessen Entwicklungstrend, wobei die Costa, R1 und R4+5 (vielleicht auch R2+3) zunehmend verschmelzen. In den Diagnosen wird jedoch nicht erwähnt, daß R4+5 offenbar nur beim Weibchen von *Corynoneura* vorhanden ist und beim Männchen mehr oder weniger reduziert zu sein scheint. Der Grad der Verschmelzung der erwähnten Adern kann bei der Bestimmung hilfreich sein.

Puppe (vgl. Zavrel 1928, Lenz 1939).

Exuvie ohne Thorakalhorn, mit für die meisten Chironomiden charakteristischem Borstenbesatz. An den Segmenten 3 bis 8, vier Lateralborsten. Auf Tergit 7 scheinen oft 5d-Borsten zu stehen; ihre Zahl pflegt jedoch auf den vorderen Segmenten geringer zu sein. Zusätzlich zu den 3 Analborsten, wie

sie charakteristisch für Ortholadiinen sind, kommt noch ein viertes (? plesiomorphes) medianes Paar vor. Die Beborstung zeigt eine starke Tendenz zur Entwicklung von Schlauchborsten, die jedoch nicht immer erkennbar sein muß. Die Chagrinierung der Segmente ist ziemlich einheitlich und besteht aus kleinen Spitzchen, die sich auch auf die Analsegmente ausdehnen; Reihen von stärkeren intersegmentalen Dörnchen reichen auf die Analränder der Tergite und Sternite (2) 3–7. Ihre Ausbildung scheint zwischen den Populationen zu variieren. Sie sind im Text berücksichtigt worden, weil sie leicht zu erkennen sind und ihre taxonomische Bedeutung überprüft werden sollte. Dieser sonst so charakteristische Dörnchenbesatz scheint z. B. bei *C. minuta* zu fehlen. Diese Art hat eine abweichende, wohl stärker apomorphe Chagrinierung in Form von langen Spitzchen an den Abdominalsegmenten. Lange und schmale Spitzchen kommen bei den nachstehend behandelten Arten sonst nur auf den Sterniten 1 und/oder 2 vor.

Larve (vgl. Zavrel 1928, Lenz 1939 und Cranston & al. 1983).

Kopf länglich, glatt oder mit verschiedenartigen Oberflächenstrukturen. Antennen nahezu so lang oder länger als der Kopf, 4gliedrig, 3. und 4. Glied verwachsen. Nach Lenz (1939: 17) hat Goetghebuer bei den Larvulae ein zweiteiliges Antennenbasalglied gesehen. Erstes Glied etwa so lang wie die Summe der Endglieder; Unterschiede zwischen den Arten scheint es u. a. in der absoluten Länge und im Längenverhältnis der einzelnen Glieder zu geben; 2. Glied etwas geknickt. Ringorgan etwa in der Mitte des ersten Gliedes, zwei winzige Borsten in der distalen Hälfte; apikale Blattborste des ersten Gliedes sehr kurz. S_1 einfach. Zahnleiste der Labialregion mit oder ohne kleinem, unpaaren Medianzahn und 6 Lateralzähnen. Mandibeln neben dem Apikalzahn (bei den vorliegenden Larven) mit 4 Lateralzähnen, von denen der erste am größten ist; ssd klein, bei si können nach Zavrel (1928: 655) Unterschiede zwischen den Arten existieren. Prämandibeln mit mehreren kleinen Zähnen, von denen die am weitesten ventralen am breitesten sind. Maxillen Fig. 9: 7. Thorakalsegmente 2 und 3 verwachsen. Ansonsten zeigen die Larven den normalen Habitus der Chironomiden. Zwei Ventralborsten von Segment 10 sind auffallend stark und oft verzweigt. Vier Analpapillen.

Dem vorliegenden Manuskript liegen teilweise Untersuchungsergebnisse zu Grunde, die schon vor mehr als 20 Jahren zusammengestellt worden sind. Ein erheblicher Teil der Präparationsarbeiten und Messungen an finnischen *Thienemanniella-* und *Corynoneura*-Arten ist seiner Zeit von Mag. phil. Elina Hirvenoja vorgenommen worden.

Für eine befriedigende taxonomische Beurteilung der *Corynoneura*-Arten sind die Weibchen ebenso wichtig, wie die Metamorphosestadien. Auf Grund unserer damaligen Erfahrungen können einige Auffassungen von Schlee (1968) nicht akzeptiert werden. Bedauerlicherweise waren wir seitdem nicht in der Lage, eine umfassende Monographie der Gattung durchzuführen. Ein großes Hemnis war dabei die Schwierigkeit, die Taxonomie von *C. scutellata*, der Typusart der Gattung *Corynoneura* zu klären. Dieses war im Herbst 1987 möglich.

Schlee (1968) beschreibt die Männchen, der ihm vorgelegenen Arten sehr gründlich. Nachstehend werden seine Angaben noch ergänzt mit Meßwerten und Beschreibungen, die insbesondere an den selben Populationen von den beiden Geschlechtern gemacht werden konnten. Die Zahlenangaben basieren zwar nur auf relativ wenigen Individuen, dürften aber einer allgemeinen Orientierung sehr dienlich sein, zumal z. B. der LR-Wert erfahrungsgemäß höchstens um etwa 0,1 variiert. Die Beborstung (siehe Brundin 1956: 172) der behandelten Arten ist von uns auch untersucht worden, aber weil die Unterschiede zwischen den Arten nicht überzeugend sind, wird auf sie nicht weiter eingegangen. Es wird ebenfalls auf die BR-Werte verzichtet, die etwa 3,5 erreichen und keine erkennbaren Artenunterschiede erkennen lassen.

Aufgrund unserer neueren Erfahrungen ist die Chagrinierung der Exuvie besser an getrockneten als an in Euparal eingebetteten Häuten zu sehen. Es lassen sich auch Unterschiede in der Gestalt der Dörnchen, wenigstens zwischen den Artengruppen, erkennen. Sie sind jedoch nachstehend nicht genügend berücksichtigt worden. Leider stand nicht ausreichend genug unpräpariertes Material zur Verfügung.

Die Corynoneura scutellata-Gruppe

Zu den auffälligsten morphologischen Veränderungen innerhalb der Gattung *Corynoneura* gehören die Trends bei der Ausbildung des Sternapodems X und der Phallusarmatur. Die Richtung der Anagenese ist wahrscheinlich

so zu verstehen, wie sie bereits von SCHLEE (1968: 145) aufgezeigt wurde. Am Ende dieser Entwicklungsrichtung steht nach SCHLEE (1968) *C. celtica* Edw. in seinem Sinne (diese Art ist jedoch *C. brevipennis* Goetgh.). SCHLEE (l. c.) verwendet für die Begründung der stammesgeschichtlichen Beziehungen in erster Linie die Strukturen des Sternapodem X und der Phallusarmatur. Andere Merkmale wurden von ihm als weniger aussagekräftig interpretiert. Zu den letzteren gehört u. a. der Bau der Antennen, der von den älteren Autoren als wichtig betrachtet wurde und, wie gezeigt werden kann, nicht zu vernachlässigen ist. Ein besonders wichtiges Merkmal bei der Beurteilung der Weibchen sind die Antennen. Sie zeigen ähnliche Tendenzen in der Entwicklung der Beborstung wie die Männchen. Der Stammbaum von SCHLEE (1968: 145) weist hier schwer zu deutende Diskrepanzen auf. Immer wieder befinden sich getrennt von einander Arten, in denen sowohl bei den Männchen als auch bei den Weibchen Antennen eine Apikalrosette besitzen und daneben die Hintertibien gleichzeitig auch eine stark s-förmige Apikalborste („A"

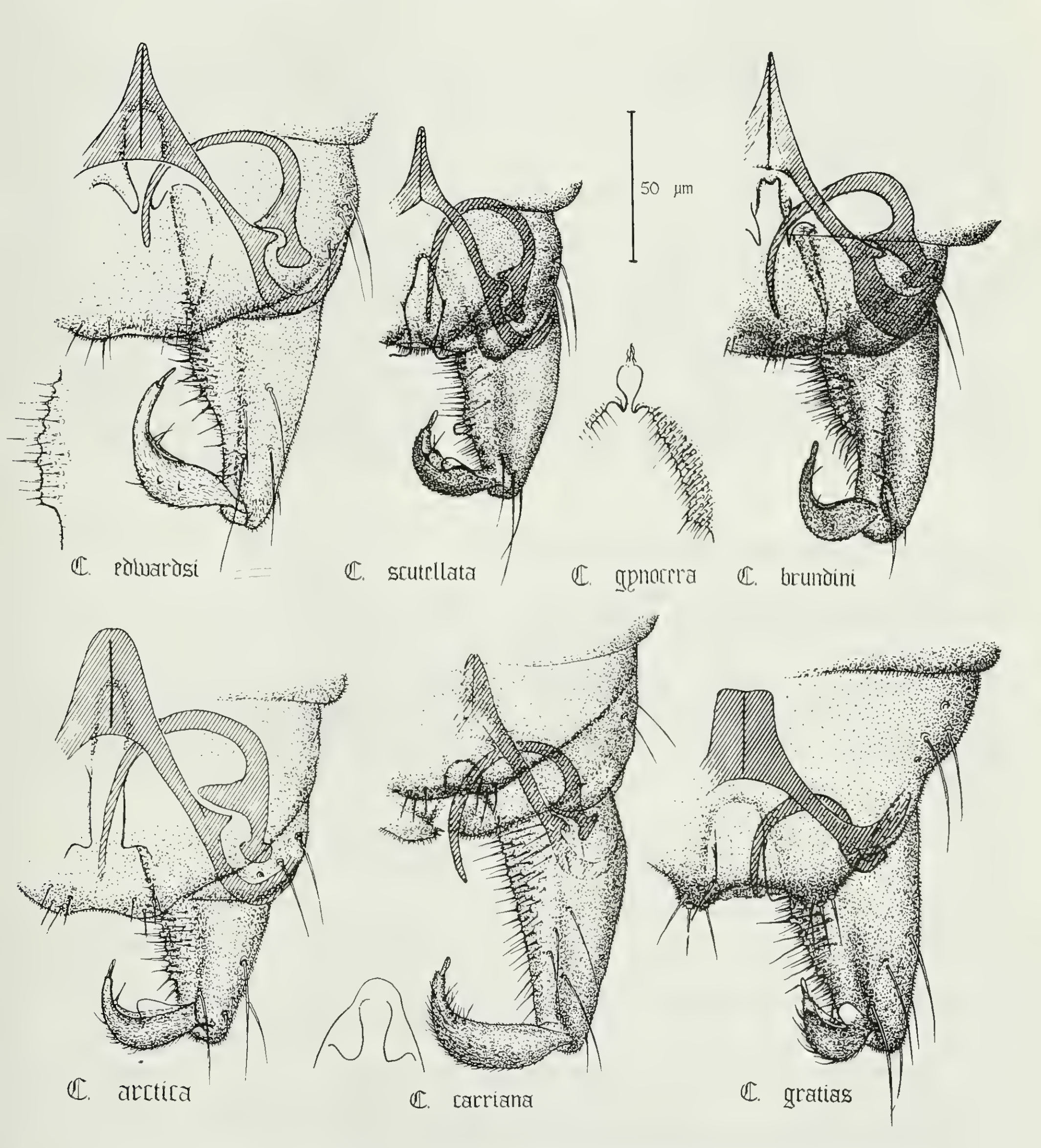


Fig. 2: Hypopygien von *Corynoneura*-Arten der *scutellata-*, *edwardsi-* und *carriana*-Gruppe.

bei Fig. 112 von SCHLEE 1968) tragen. Natürlich sind solche gemeinsam auftretenden Strukturen als Parallelismen denkbar, aber ebenso wahrscheinlich ist auch eine parallele Entwicklung des Hypopygiums in verschiedenen Linien.

Eine befriedigende Diskussion dieser Problematik ist derzeit mit dem vorliegenden Material noch nicht möglich. Hennig und Brundin haben oft genug betont, daß die phylogenetische Systematik das Suchen der Schwesterarten oder -gruppen ist. Es wird sich zeigen müssen, ob die hier zusammengestellte *scutellata*-Gruppe monophyletisch ist. Sie besteht aus einander sehr ähnlichen Arten, die bisher nicht gut unterschieden werden konnten. Viele der gemeinsamen Merkmale scheinen Symplesiomorphien zu sein, z. B. der Bau der Antennen oder die Innenkontur des Hypopygiums, vielleicht auch der „Doppelstylus".

Diagnose

Imagines bräunlich, grünlich getönt. Antennen des Männchens 11gliedrig; Apikalteil des letzten Gliedes keulig verdickt, gegen das Ende zugespitzt, distal proximalwärts bis über die Verdickung mit Sensilla chaeticae besetzt; im Proximalteil des letzten Antennengliedes viele normale Antennenborsten. Antennen des Weibchens 7gliedrig, entspricht im Bau dem der Weibchen der Familie, wobei letztes Glied Sensillen nahezu auf der ganzen Länge bis zum Apex trägt. Auf dem Flügel erreichen die Costa bzw. der Clavus beim ♀ etwa 1/3, beim ♂ kaum die Hälfte der Flügellänge; beim ♀ R4+5 mit den vorderen Teilen des Clavus wenigstens bis zur Hälfte des Clavus verschmolzen, beim ♂ ist der Clavus höchstens etwa zweimal länger als breit. Hypopygium des ♂ mit Styli, die eine mehr oder weniger lobusähnliche Crista dorsalis tragen; die proximalen Anhänge (?PV) reichen etwa bis zur Mitte der Gonocoxite. Puppe mit langen Spitzchen auf 2. Sternit oder oft auch an den Lateralteilen vom 1. Sternit. Eindeutige Gruppenmerkmale fehlen jedoch im Puppenstadium. Larven mit einer Kopfkapsel, die mehr oder weniger deutliche Skulptur zeigt. Antenne länger als der Kopf. Zahnleiste der Labialregion mit einem kleinen, unpaaren Medianzahn und 6 etwa gleichgroßen Lateralzähnen. Die großen Ventralborsten von Segment 10 mit langen proximalen Nebenstacheln, die individuell zu variieren scheinen.

Corynoneura gratias Schlee (1968: 26–29, ♂)

Typus-Material ist nicht vorhanden. Die Artbeschreibung bei Schlee ist jedoch eindeutig.

Imago, ♂

AR 0,77–1,00, LR 0,52–0,60. Als Ergänzung zur Originalbeschreibung einige Werte (n = 3; Material aus dem Fluß Puujoki, Ryttylä, Hausjärvi, Südfinnland, Juni/Juli 1964 gezüchtet). Palpenglieder: 18–22, 22–27, 27–31 und 45–54 μm. Flügellänge etwa 1 mm; der Clavus etwa zweimal so lang wie breit.

Beine in μm:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	268-299	321-366	192-214	96-107	54-63	18-27	31-36	0.58-0.61
P_2	384-429	348-402	219-232	94-107	45-58	18-18	34-40	0.58-0.61
P_3	313-357	339-375	188-219	94-107	40-49	18-18	36-40	0.53-0.58

Charakteristisch für das Hypopygium ist das Gelenk des Phallapodems. Arttypisch sind auch die im Vergleich zu anderen Arten der *C. scutellata*-Gruppe stärkeren Borstenbuckel am Hinterrand des Analtergits wie auch die Kürze des Phallapodems. Gonocoxite ohne Innenlobus.

Imago, ♀

Zusammen mit den obigen Männchen wurden viele Exemplare von *C. edwardsi* gezüchtet, aber ein neugeschlüpftes Weibchen war verschieden und wegen des rundlichen dritten Palpangliedes, der Beinmaßen und Merkmalen der Puppenexuvie konnte es als *C. gratias* bestimmt werden. Maße der Palpen: 13, 17, 17 und 40 μm. Flügel geschrumpft, Clavus ähnelt *C. scutellata.*

Beine in μm:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	214	268	156	67	36	18	36	0.58
P_2	304	313	183	63	40	18	36	0.58
P_3	260	277	161	71	31	18	36	0.57

Spermatheken oval, etwa 80 μm.

Puppe

Material: Puujoki, vgl. oben.

Länge der Exuvie 2,2–2,3 mm. Vorderteil des Nahtrandes schmal, schwach gekörnelt oder gedornt. An den Flügelscheiden 1–4, meist verhältnismäßig schwache Perlenreihen. Schwer sichtbare (? kurze) Spitzchen auf Sternit 2. Dorsale Chagrinierung auf den Segmenten 2–9, fehlt lateral von den d-Borsten. Intersegmentale Dörnchen an den Hinterrändern der Segmente 3–7, dorsal und ventral meist weniger als 10 (4–12) in jeder Reihe. Die (?4) l-Borsten von Segment 2 einfache Spitzborsten. Gonopodenscheiden des Männchens enden zwischen dem Hinterrand des Analsegments und den Sockeln des medianen Analborstenpaares. Scheiden der Cerci des Weibchens enden weit vor dem medianen Analborstenpaar. Schwimmhaarsaum des Analsegments mit 33–47 Borsten (n = 7).

Larve

Material: Puujoki, vgl. oben, Zuordnung nicht sicher.

C. gratias lebte in dem Fluß Puujoki u. a. zusammen mit *C. edwardsi.* Die Larvenhäute einer Einzelzucht von *C. edwardsi* aus Tvärminne (wie einige aus Puujoki) hatten kürzere Antennen als die Larvenhäute des letzten Larvenstadiums einiger Larven, die hier als zu *C. gratias* gehörig aufgefaßt worden sind. Kopfkapsel schwach und unregelmäßig skulpturiert. Antenne 370–390 μm lang, höchstens 1/4 länger als der 320–360 μm lange Kopf; Längenverhältnisse der Antennenglieder: 100:39:47:3; 100:38:44:3; 100:34:46:3.

Mundteile wie bei *C. scutellata.* Die großen Ventralborsten von Segment 10 nahezu einfach, nur mit kleinen, proximalen Nebenstacheln besetzt.

Verbreitung

In Finnland ist *C. gratias* etwa bis zum 62°N bekannt.

Corynoneura scutellata Winnertz (1846: 13, ♀)

Neotypus, ♀, aus der Kollektion Winnertz, in Euparal eingebettet, Muséum National d'Histoire Naturelle, Paris. Dort auch noch ein genadeltes anderes, unpräpariertes Weibchen.

Synonymie

Corynoneura lemnae Schiner (in FRAUENFELD 1866: 974, Imago)

Syntypen, 4 ♀ in einer Glastube im Naturhistorischen Museum Wien. Ein Exemplar davon in Euparal gebettet, als Lectotypus hier festgelegt. Den vorliegenden Individuen fehlen die Antennen oder wenigstens das letzte An-

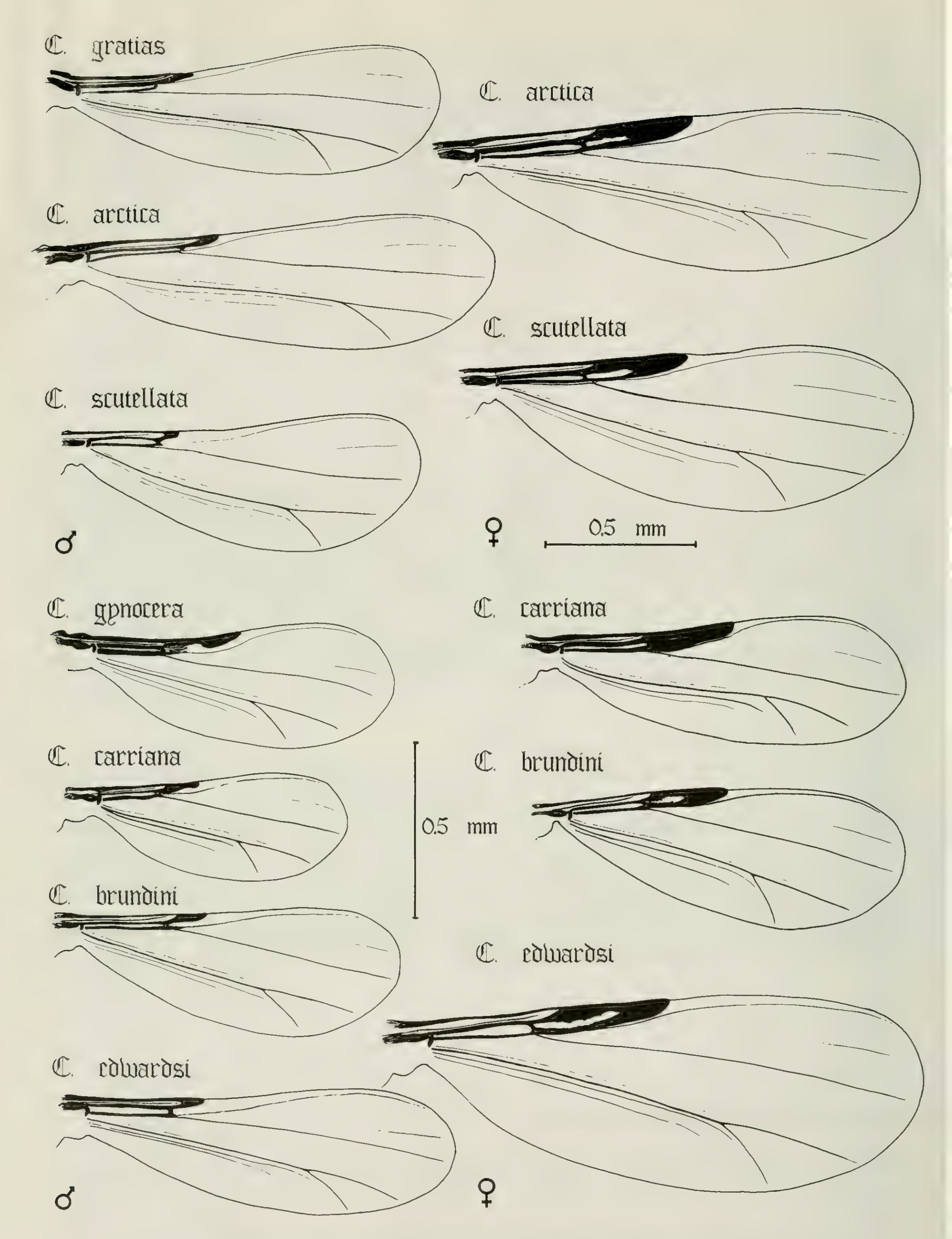


Fig. 3: Flügel von *Corynoneura*-Arten der *scutellata*-, *carriana*- und *edwardsi*-Gruppe.

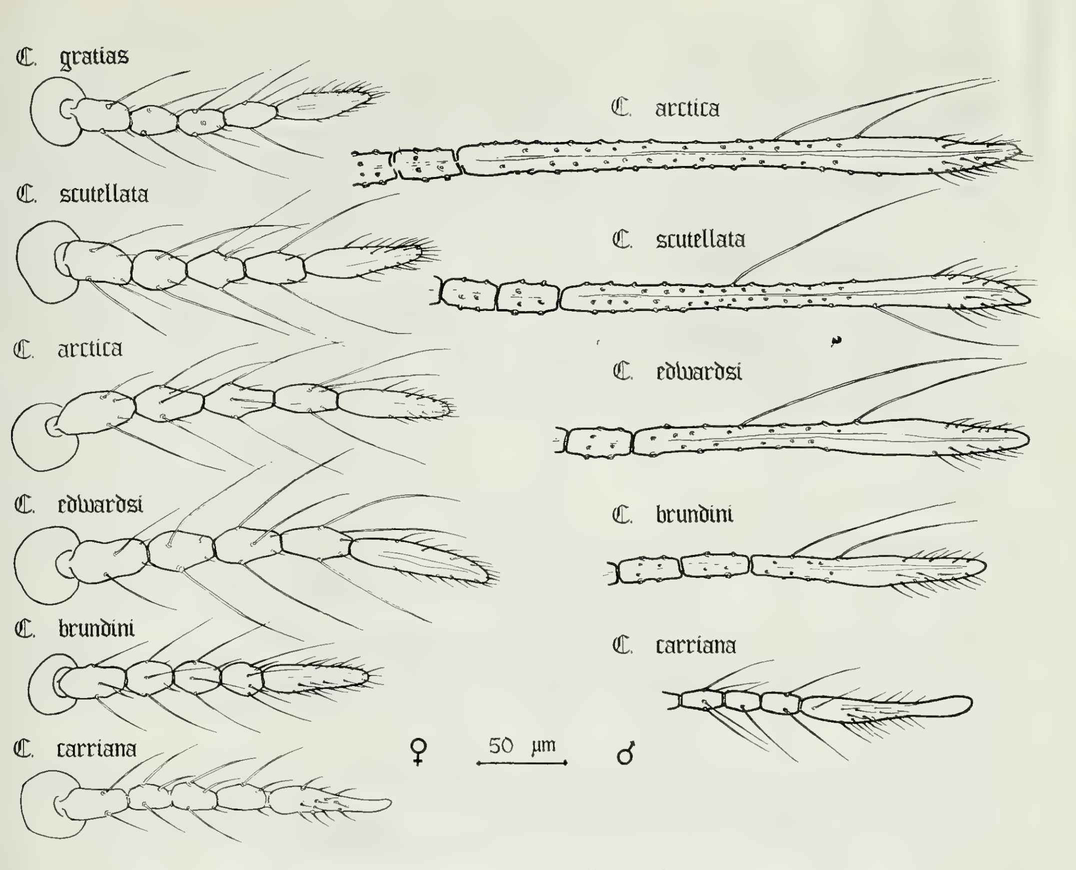


Fig. 4: Antennen der *Corynoneura*-Arten der *scutellata-*, *edwardsi-* und *carriana*-Gruppe.

tennenglied, aber die charakteristische Apikalborste (A) am Ende der Ti/P_3 belegt eindeutig die Zuordnung, da dieses Merkmal bisher von keiner Art sonst aus Europa bekannt ist.

Corynoneura innupta Edwards (1919: 226, ♀)

Syntypen, 4 ♀ aus Letchworth, Hertfordshire, England; VI. 1918, F. W. Edwards leg. Ein Exemplar davon in Euparal gebettet, hier als Lectotypus festgelegt.

Corynoneura longipennis Tokunaga (1936: 50, ♂ und ♀)

Das Typusmaterial (siehe TOKUNAGA 1936: 51) wurde i. J. 1964 untersucht und konnte nicht von den aus Finnland vorliegenden bisexuellen Exemplaren unterschieden werden. Das Material war damals nicht in Kyoto, wie in der Originalbeschreibung erwähnt wird, sondern in dem entomologischen Laboratorium der Universität Kyushu, Fukuoka, Japan. Es war jedoch nicht möglich, die Artidentität der parthenogenetischen und der bisexuellen Populationen zu beweisen. Geringe Unterschiede bei den Puppenexuvien und Imagines der vorliegenden Populationen lassen sich nicht werten.

Allgemeine Bemerkungen

Die Maßangaben beziehen sich jeweils auf 5 ♂ und 5 ♀ von mehreren Lokalitäten in Riihimäki, Südfinnland, wo diese Art auch, aus einem Tonstich stammend (T_1), 1964 im Laboratorium gezüchtet werden konnte. Die Zuchten ergaben sowohl Männchen als auch Weibchen. Es zeigte sich später, daß sich in den Aquarien viele Jahre hindurch auch eine parthenogenetische Population hielt, die sich nicht von den bisexuellen Tieren unterscheiden ließ. Der genaue Ursprung der parthenogenetischen Population konnte nicht geklärt werden. Das Schlüpfen der Imagines vollzog sich täglich.

Nach FRAUENFELD (1866: 974) sollten die Puppen von *C. lemnae* zu beiden Seiten des Anallobus nur 8 Borsten und die Larven nur 2 Analpapillen haben. Falls diese Beobachtungen der Wirklichkeit entsprächen, wäre die obige Synonymisierung mit der bisexuellen Population fraglich. Weil das Typusmaterial aber sowohl von *C. scutellata* als auch von *C. lemnae* aus Weibchen besteht, ist es jedoch wahrscheinlich, daß beide aus parthenogenetischen Populationen stammten. EDWARDS (1919: 226.227) schildert ein ähnliches Zuchtergebnis aus seinem Labor im Zusammenhang mit der Beschreibung von *C. innupta (innupta* = Jungfrau). Er bezweifelt allerdings, daß sich die Angabe von Goetghebuer (siehe LENZ 1939: 17) über die Parthenogenese von *C. celeripes,* also auf *C. scutellata,* auf *C. innupta* beziehen. Dies dürfte jedoch zutreffen, denn wie bereits erwähnt, hatte KIEFFER (1899) eindeutig eine Art der *C. scutellata*-Gruppe als *C. celeripes* Winn. neubeschrieben und illustriert.

Imago, ♂

AR 0,77–1,00. Palpenglieder: 17–24, 24–29, 31–36 und 50–62 μm. Flügellänge: 1,0–1,2 mm; der Clavus 1,5 oder höchstens zweimal so lang wie breit.

Beine in μm:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	238-305	333-371	195-219	105-114	57-67	29-33	42-43	0.55-0.60
P_2	362-433	376-400	210-229	95-105	48-57	20-29	33-43	0.54-0.60
P_3	305-362	333-429	195-248	100-114	48-48	29-29	38-43	0.57-0.59

Apikalborste (A) von Ti/P_3 senkrecht zur Längsachse von Ti, kurz S-förmig. Charakteristisch für die Art ist auch ein sehr kleiner, unter dem Stylus leicht unsichtbar bleibender Innenlobus der Gonocoxite. Gelenkzapfen des Penisapodems in dem Sternapodem X lateral gerichtet.

Imago, ♀

Letztes Antennenglied etwa so lang wie 1,5–2 der vorhergehenden zusammen. Palpenglieder: 17–19, 22–26, 26–31 und 50–55 μm. Flügellänge etwa 1,1 mm; die distale Hälfte des Clavus verwachsen, aber an der proximalen Hälfte R4+5 weit von dem Vorderteil des Clavus getrennt.

Beine in μm:

	Fe	Ta_1	Ta_2	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	238-286	276-357	152-190	76-95	38-57	29-29	38-43	0.51-0.58
P_2	343-405	310-390	190-238	76-95	43-57	24-29	33-48	0.58-0.62
P_3	295-352	290-384	171-219	86-100	38-48	24-29	38-43	0.53-0.57

Apikalborste wie beim Männchen, kurz S-förmig. Sie ist das wichtigste Merkmal bei der Bestimmung der Art innerhalb der Gruppe. Besonders bei parthenogenetischen Tieren die letzten Tarsenglieder und die Enden der anderen Glieder etwas verdunkelt. Spermatheken oval, etwa 80 μm.

Puppe

Material: Riihimäki und Tvärminne, Südfinnland, M. H. leg., vgl. auch LANGTON 1984, sub *innupta.*

Exuvie 2.0–2.4 mm lang. Nahtrand schwach gekörnelt. An den Flügelscheiden 1–4 kurze Perlenreihen, oft sehr schwach ausgebildet. Chagrinierung auf allen Segmenten, das 1. ausgenommen. Lange Spitzchen auf Sternit 2. Lateralteile von Sternit 1, besonders bei den parthenogenetischen Tieren, mit Spitzchen wie bei *C. arctica.* Sterniten 3–5 (6) spärlich mit winzigen Dörnchen bis zum Lateralrand der Segmente. Intersegmentale Dörnchen, etwa 10 (7–12), an den Hinterrändern der Tergite und Sternite 3–7. Gonopodenscheiden des ♀ enden etwa in der Mitte zwischen den Sockeln der medianen Analborsten und dem Hinterrand des Analsegments; ihre Gestalt ist auch unter dem Deckglas stärker wurstförmig als bei anderen Arten. Scheiden der Cerci beim ♀ enden weit vor dem medianen Analborstenpaar. Schwimmhaarsaum mit 31–42 Borsten.

Auf Segment 2 waren im obigen Material, die Borsten l_1 und l_2 oft eine Schlauchborste. Aus dem See Puruvesi liegen Puppenexuvien, B. Lindeberg leg., vor, bei denen l_1-l_3 bzw. l_1-l_4 Schlauchborsten sind. Obgleich die Zugehörigkeit der Exuvien nicht mit Zuchten belegt war, wird hier intraspezifische Variation vermutet. Die Puppe von *C. scutellata* ähnelt sehr der von *C. gratias.* Wenn beide nebeneinander liegen, ist die Unterscheidung durch den Habitus möglich, aber für eine Einzelbestimmung sind kaum andere Merkmale als die schwachen Unterschiede in der lateralen Chagrinierung der mittleren Segmente und die Unterschiede am Analsegment zu verwenden. Die Arten sind jedoch bisher nie nebeneinander vorkommend angetroffen worden.

Larve

Material: Riihimäki.

Wenigstens auf dem Hinterteil der Kopfkapsel, allerdings nur mit starker Vergrößerung sichtbar, mit netzartiger Skulptur; nur in einem Falle, bei dem größten Larvenkopf, war die Skulptur nahezu ebenso deutlich wie auf dem Kopf von *C. arctica.* Antenne etwa 340–450 μm lang, etwa 1/4 länger als der etwa 300–340 μm lange Kopf; Längenverhältnisse der Antennenglieder: 100:42:43:3; 100:49:53:3; 100:46:51:3.

Weitere Strukturen der Larve auf Fig. 10.

Verbreitung

In Finnland ist *C. scutellata* aus Brackwasser, Flüssen, Seen und Teichen von der Südküste bis Lappland bekannt (bei Tuiskunen & Lindeberg 1986 sub *C. longipennis).*

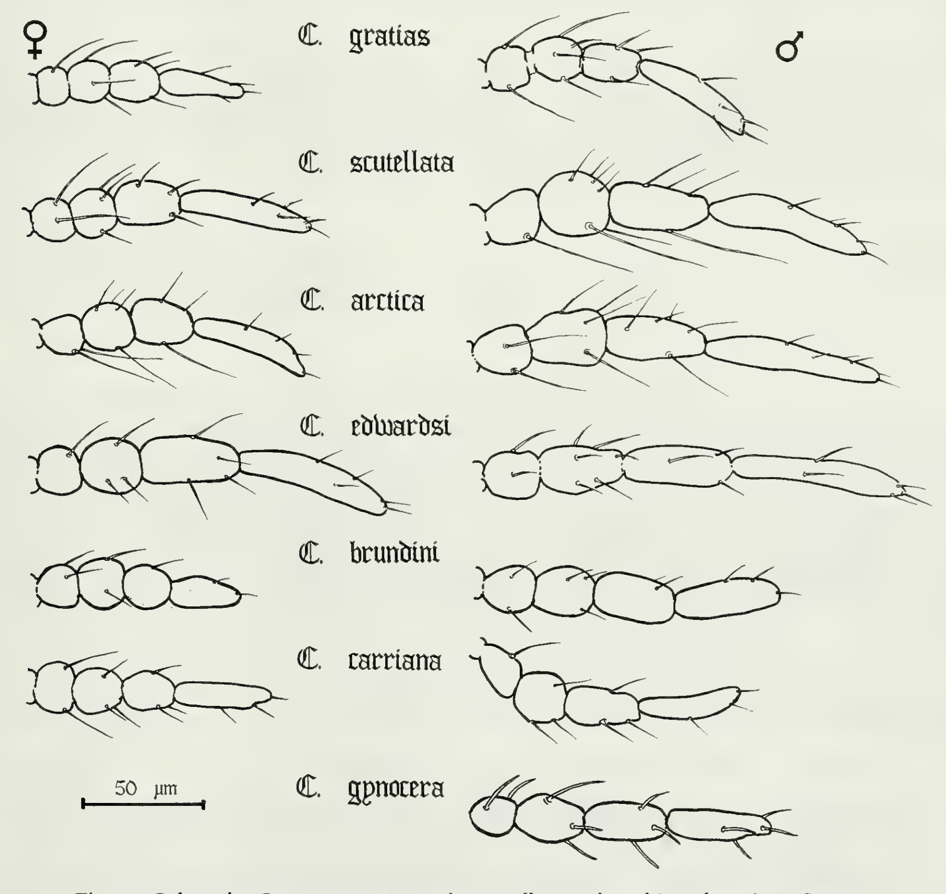


Fig. 5: Palpen der *Corynoneura*-Arten der *scutellata-*, *edwardsi-* und *carriana*-Gruppe.

Corynoneura arctica Kieffer (1923: 4, ♂)

Lectotypus ♂, designiert von D. R. Oliver, aus Novaja Semlja, F. Økland leg. in den Sammlungen des Zoologischen Museums der Universität Oslo.

Material: 3 ♂ und 2 ♀, aus dem Fluß Luiro, Sodankylä, Finnisch-Lappland, August 1960; 2 ♂ und 2 ♀ aus einem Torfstich in Riihimäki, Südfinnland, Mai–Juni 1962, M. H. leg.; 1 ♂, 1 ♀, Felsentümpel bei Tvärminne an der Südküste Finnlands, B. Lindeberg leg.

Imago, ♂

AR 1,02 (0,87–1,09). Palpenglieder: 22–26, 29–34, 36–46 und 67–82 μm. Flügellänge 1,1–1,4 mm; der Clavus etwa zweimal so lang wie breit. Beine in μm:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	314-362	371-429	210-238	114-124	67-76	29-33	38-48	0.53-0.57
P_2	438-505	424-476	238-257	114-119	62-67	29-29	48-48	0.56-0.59
P_3	376-419	429-464	250-268	123-138	57-67	29-33	43-48	0.54-0.60

Apikalborste (A) von Ti/P_3 etwas gekrümmt, steht in einem ein wenig größeren Winkel zur Tibiallängsachse als bei *C. gratias*. Hypopygium mit Gelenkzapfen des Penisapodems, der lateral gerichtet ist. Gonocoxite ohne Innenlobus.

Imago, ♀

Letztes Antennenglied etwa so lang wie die zwei vorhergehenden zusammen. Palpenglieder: 17–22, 23–34, 30–34, 30–36 und 48–60 μm. Flügellänge 1,2–1,3 mm; Clavus nahezu vollständig (wenigstens bei typischen Exemplaren) verwachsen. Beine in μm:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	280-395	357-371	190-210	90-105	52-57	20-33	38-43	0.53-0.59
P_2	419-429	390-414	229-252	105-105	52-57	26-33	38-48	0.57-0.64
P_3	348-376	393-429	225-241	110-119	43-48	24-33	38-48	0.56-0.60

Aus dem kleinen See Posolampi (ein *Cladotanytarsus*-See), nicht weit vom oligotrophen Fluß Luiro in Sodankylä, schlüpften 1962 in den Fangtrichtern eine große Zahl Weibchen, die eine parthenogenetische Population oder jedenfalls ein sehr abweichendes ♂-♀-Verhältnis repräsentierten. Die Tiere sind kleiner als die ursprünglich beschriebenen, aber aufgrund der Puppenexuvien und des LR-Wertes konnten sie als *C. arctica* bestimmt werden. Es ist nicht auszuschließen, daß die erwähnte Kleinheit und das abweichende ♂-♀-Verhältnis von dem Lebensraum abhängt. Die Arten auch anderer Chironomiden-Gattungen waren dort kleiner als in anderen Gewässern. Die genauen Werte werden hier gegeben, weil die Exemplare wegen der geringen Größe sehr *C. gratias* und auch *C. edwardsi* ähnelten, von denen in demselben Biotop eine deutlich bisexuelle Population vorkam. Die Beinlängen in μm:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	210-250	254-304	143-170	66- 85	38-39	18-18	34-36	0.56-0.57
P_2	311-366	281-339	165-213	76- 98	40-46	18-19	31-40	0.59-0.63
P_3	268-339	277-348	154-192	84-105	36-45	21-19	31-40	0.55-0.55

Apikalborste (A) von Ti/P_3 wie beim ♂. Spermatheken etwa 75–80 μm. Sowohl beim ♂ als auch beim ♀ sind die drei letzten Tarsusglieder und die Apikalenden der anderen Beinglieder bisweilen etwas verdunkelt. Vielleicht

ist dies eine Eigenschaft, die auch bei anderen Arten mehr oder weniger deutlich ausgeprägt ist, aber vor allem bei mit Fangtrichtern gesammelten und in Alkohol aufbewahrten Tieren nicht zu sehen ist.

Puppe

Material: Riihimäki, Südfinnland und Sompio-Gebiet in Sodankylä, Finnisch-Lappland, M. H. leg.; Tvärminne, B. Lindeberg leg.

Exuvie 2,1–2,8 mm lang. Nahtrand schmal, schwach gerunzelt oder gekörnelt. Die erste deutliche Perlenreihe an den Flügelscheiden kurz, dazu kommen weitere 2–4 mehr oder weniger deutliche Reihen. Chagrinierung auf allen Segmenten; auf den Sterniten 3–5 kleine Spitzchen, spärlich, bis zum Lateralrand des Segments. Intersegmentale Dörnchen an den Analrändern der Tergite und Sternite 3–7 je mit mehr als 10 (10–18), bei britischen Exemplaren weniger; auf Tergit 2 bei Puppenhäuten aus Finnland eine unregelmäßige Reihe mit wenigen Dornen. Lange Spitzchen auf Sternit 2. An den orallateralen Ecken von Sternit 1 sind diese Spitzchen verhältnismäßig lang, in der Mitte des Sternits sehr klein. Gonopodenscheiden des ♂ reichen bis zum Hinterrand des Analsegments oder sind etwas länger. Scheiden der Cerci beim Weibchen reichen nicht zu den Sockeln des medianen Analborstenpaares. Schwimmhaarsaum des Analtergits mit 40–50 Borsten.

Larve

Material: 1 aus Tvärminne, Finnland, B. Lindeberg leg; 2 Larven mit Puppenexuvien ohne Imagines, sub *innupta* Edw. aus der Sammlung des British Museum, London, S. O. Howard leg., konnten nicht von dieser unterschieden werden.

Kopfkapsel mit ziemlich starker netz- oder schuppenförmig angeordneter Skulptur. Antenne 495–560 μm lang, etwa 1,5mal länger als der etwa 370 μm lange Kopf; Längenverhältnisse der Antennenglieder: 100:40:36?(fehlt) (Tvärminne); 100:41:41:2; 100:42:38:2 (England).

Die großen Ventralborsten von Segment 10 entweder mit wenigen oder vielen proximalen Nebenstacheln (die britischen Tiere mit wenigen zarten proximalen Ästen; bei der Larve aus Finnland die andere Borste mit vielen Ästen besetzt).

Verbreitung

In Finnland in Schmelzwasserlachen, Tümpeln, Flüssen und Seen von den Felsentümpeln an der Südküste bis Lappland (bei Tuiskunen & Lindeberg 1986 sub *C. scutellata*).

Die Corynoneura edwardsi-Gruppe

Die Begründung von Schwesternarten sollte nach Möglichkeit von apotypischen Arten ausgehen. Auf den ersten Blick sehen die Arten der *C. edwardsi-* oder *C. carriana*-Gruppe ziemlich abgeleitet aus, aber bei näherer Betrachtung zeigen sich viele plesiomorphe Züge. Die Abgrenzung einer *C. edwardsi*-Gruppe mag unnötig erscheinen, aber sie erleichtert in jedem Fall die artliche Zuordnung bei der Bestimmung.

Betrachtet man die Antennen oder die Strukturen des Hypopygiums beim Männchen, scheinen die Arten der *C. edwardsi*-Gruppe das Ergebnis gewisser Reduktionstendenzen von der anagenetischen Stufe der *C. scutellata*-Gruppe zu sein. Auch die Unterscheidung der Weibchen oder der Metamorphosestadien beider Gruppen voneinander ist bisweilen sehr schwierig. Der Bau des Flügels, der der Puppe und der Larve in der *C. edwardsi*-Gruppe zeigen im Vergleich zu allen Arten der *C. scutellata*-Gruppe jedoch relativ ursprünglichere Züge.

Die *C. edwardsi*-Gruppe wird hier als die unmittelbare Schwestergruppe zur *C. scutellata*-Gruppe verstanden. Innerhalb der *C. edwardsi*-Gruppe, ist *C. brundini* als eine apomorphe Schwesternart von *C. edwardsi* aufzufassen.

Diagnose

Die Imagines ähneln in vielen Merkmalen denen der *C. scutellata*-Gruppe. Antenne 11gliedrig, letztes Antennenglied kurz. Palpen können länger sein. Beim Flügel des ♂ nehmen die starken Vorderrandadern wenigstens 2/5, beim ♀ wenigstens die Hälfte der Flügellänge ein. R4+5 deutlich erkennbar bis zur Hälfte, beim ♀ bis 2/3 von der Länge des Clavus. Beim ♂ Clavus wenigstens zweimal

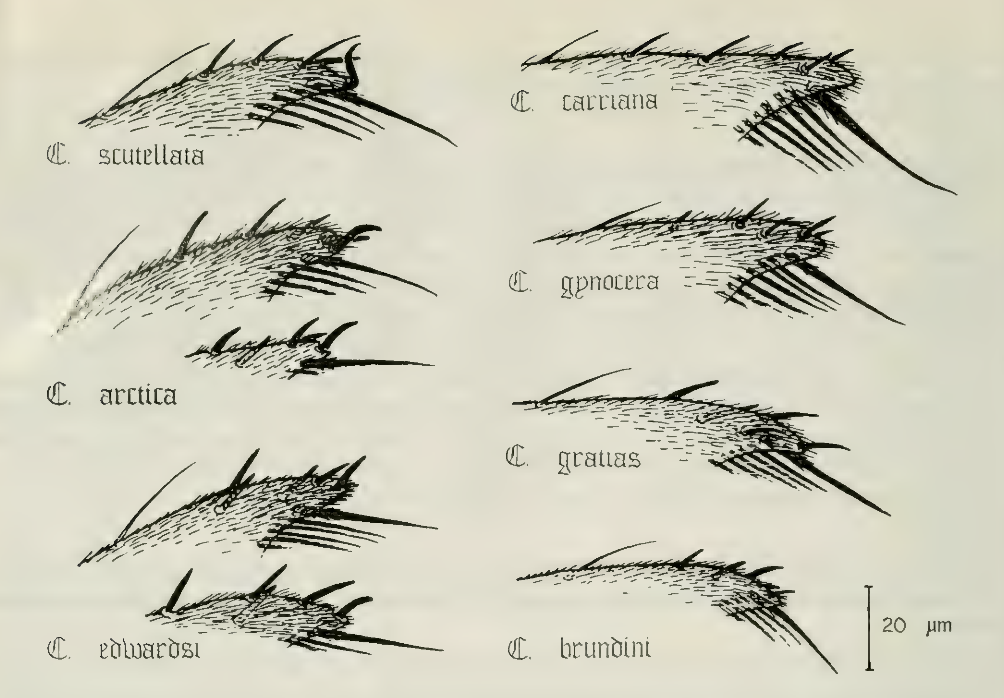


Fig. 6: Apikalenden der Hintertibien der *Corynoneura*-Arten der *scutellata-*, *edwardsi-* und *carriana*-Gruppe.

so lang wie breit. Apikalborste (die Borste „A" bei Schlee 1968, Fig. 111–112) der Hintertibien nur schwach gekrümmt. Medianteil des Sternapodems X beim Hypopygium sehr reduziert; Gelenkzapfen des Penisapodem lateralwärts gerichtet. Penisapodem lang und stark bogenförmig. Proximaler Anhang der Gonocoxite kurz und distal spitz; im mediodistalen Teil der Gonocoxite sehr schwach angedeutet, ein breiter, flacher Lobus. Stylus einfach, aber mit mehr oder weniger leicht sichtbarer, schmaler, dorsaler Crista besetzt. Puppe mit langen Spitzchen auf den beiden ersten Abdominalsterniten. Von den Puppen und von den Larven liegen nicht eindeutige Gruppenmerkmale vor; Antenne der Larve so lang oder wenig kürzer als die Kopfkapsel.

Corynoneura edwardsi Brundin (1949: 698, 831–833, ♂)

Typusmaterial (Riksmuseum, Stockholm, Schweden).

Material: 5 ♂ und 5 ♀ aus den Seen Sompiojärvi und Seitajärvi, nebst aus dem Fluß Luiro, Sodankylä, Finnisch-Lappland, 1959–1960, M. H. leg.

Imago, ♂

AR 0,68–0,87. Letztes Flagellomer so lang wie die 6–8 vorhergehenden zusammen. Palpenglieder: 21–23, 28–32, 38–50 und 55–71 μm. Kopf und Thorax etwas, auch der Raum zwischen den Mesonotalbinden verdunkelt. Flügellänge 1,1–1,3 mm; Clavus etwa 2mal länger als breit. Beine in μm:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	298-333	377-412	197-239	101-118	57-83	26-31	35-39	0.54-0.57
P_2	417-500	377-465	228-280	101-127	57-70	26-31	35-41	0.56-0.60
P_3	346-412	355-421	206-237	96-118	39-53	22-31	35-39	0.54-0.58

Abdomen etwas verdunkelt, anale Hälfte von Tergit 7 mit hellem Fleck. Hypopygium wie in Fig. 2.

Imago, ♀

Farbe wie beim Männchen, aber der Raum zwischen den Mesonotalbinden heller. Das 6. Antennenglied so lang wie die 2–2,5 vorhergehende zusammen. Palpenglieder: 17–21, 23–29, 38–44 und 57–67 μm. Flügellänge 1,2–1,5 mm; Costa bzw. der Clavus endet etwa in der Mitte des Flügels; R4+5 nur im apikalen Drittel mit dem Clavus verschmolzen; wenn mehr, ist die Trennung der Adern jedenfalls deutlich. Beine in μm:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	263-333	325-412	162-211	70- 92	44-53	22-35	31-39	0.47-0.51
P_2	377-482	360-465	162-281	88-114	48-61	26-35	35-39	0.57-0.60
P_3	324-430	342-390	171-219	88-114	35-48	22-31	31-44	0.52-0.56

Spermatheken 80–100 μm lang, oval, vor der Mündung zu einem Hals verschmälert und gekrümmt; dieser scheint bisweilen zu fehlen oder ist wegen der Lage in Präparaten nicht immer zu sehen.

Puppe

Material: Züchtungen aus dem Fluß Puujoki, Ryttylä, Hausjärvi, Juni/Juli 1964 und aus dem Brackwasser bei Tvärminne, 23.–27.7.1970, Südfinnland; Fangtrichtermaterialien aus dem See Sompiojärvi, Finnisch-Lappland, M. H. leg.

Exuvie 2,2–2,5 mm lang. Nahtrand schmal, schwach gerunzelt und gekörnelt. Auf den Flügelscheiden eine lange und etwa 3 schwächere Perlenreihen vorhanden. Alle Puppenexuvien, die aus Finnland zusammen mit den Imagines von *C. edwardsi* angetroffen wurden, haben lang Spitzchen auf den Sterniten 1 und 2, etwa wie „*Corynoneura* Pe 1a" in der Arbeit von Langton (1984: 82–83, Fig. 25c). Nach Langton sollte *C. edwardsi* dagegen nur auf Sternit 2 solche Chagrinierung haben. Anzahl der intersegmentalen Dörnchen am Analrand der Tergite 2–7 und Sternite 3–7 etwa 10 (6–15). Beim ♂ enden die Gonopodenscheiden im Bereich des Hinterrandes des Analsegments. Beim ♀ reichen die Scheiden der Cerci nahezu an die Sockeln des medianen Analborstenpaares. Schwimmhaarsaum mit 38–48 (n = 8) Borsten.

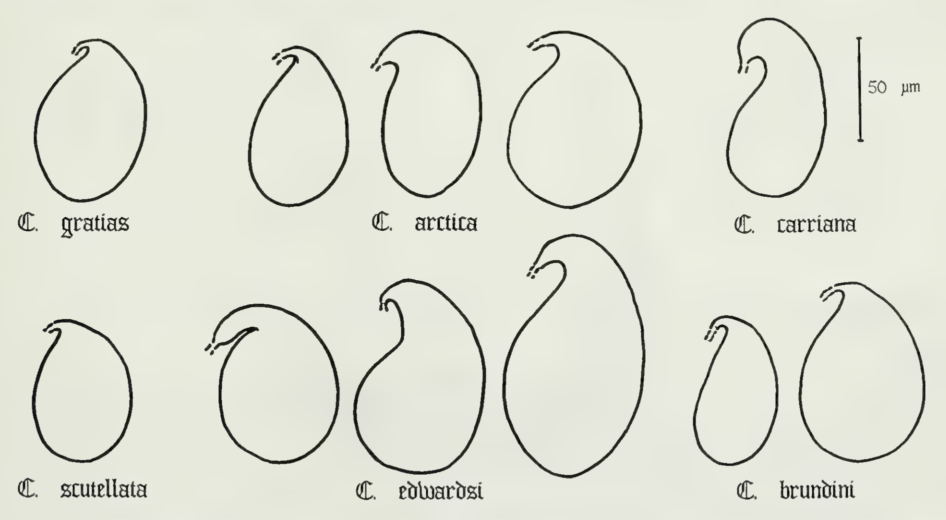


Fig. 7: Spermatheken der *Corynoneura*-Arten der *scutellata*-, *edwardsi*- und *carriana*-Gruppe.

Larve

Material: Einzelzuchten aus Tvärminne, vgl. oben.

Kopfkapsel teilweise schwach, unregelmäßig gerunzelt, im Hinterteil ist eine schwache netzartige Skulptur zu erkennen. Antenne 330–350 μm, ebenso lang oder etwas kürzer als der 330–340 μm lange Kopf; Längenverhältnisse der Antennenglieder (n = 2): 100:43:50:3; 100:42:42:2.

Labialregion mit einer Zahnleiste, bei der sich ein kleiner, unpaarer Medianzahn zwischen den verwachsenen größeren Zähnen befindet und 5 freien, etwa gleich großen Lateralzähnen. Mandibel neben dem Apikalzahn mit 4 Lateralzähnen, von denen der apikale am größten ist. Prämandibeln mit 7–8 Apikalzähnen, die breitesten und am meisten ventral liegenden sind apikal gerundet. Die großen Ventralborsten am 10. Abdominalsegment nahezu einfach, proximal nur mit undeutlichen, dünnen Nebenstacheln besetzt.

Verbreitung

C. edwardsi bevorzugt offensichtlich Flüsse und größere stehende Gewässer und lebt auch im Brackwasser. In Finnland bis Lappland bekannt.

Corynoneura brundini spec. nov.

Holotypus, ♂, und Paratypen aus dem Kleinsee Posolampi (zur Zeit ein Teil des Stausees Lokka), Sodankylä, Finnisch-Lappland, M. H. leg., in Coll. Zoologisches Museum der Universität Helsinki, Finnland. Ein Teil der 9 ♂ und 4 ♀ wurde vermessen.

Die neue Art ähnelt *C. edwardsi*, aber läßt sich von dieser u. a. durch einen kleineren AR-Wert, kürzere Palpen und die Beinmaße gut unterscheiden. Von den zahlreichen von Kieffer beschriebenen Arten mit 11gliedrigen Antennen, besitzt *C. tyrolensis* (Kieffer 1925: 565) ein etwa ebenso niedriges AR. Darüber hinaus gibt es jedoch Abweichungen im Bau der Antenne. Aus der Beschreibung von *C. tyrolensis* bei ALBRECHT (1924: 196) sind die abweichenden Merkmale (von *Eucorynoneura)* deutlich erkennbar.

Imago, ♂

Das ganze Tier etwas, auch der Raum zwischen den Mesonotalbinden dunkel gefärbt. Letztes Flagellomer mit vielen langen, normalen Antennenborsten, so lang wie die 3–3,5 vorhergehenden Glieder zusammen; AR 0,39–0,47. Palpenglieder: 24–26, 29–31, 29–34 und 34–43 μm. Flügellänge 1,0–1,1 mm; Costa bzw. Clavus reichen in die Nähe der Mitte des Flügels, Clavus 3–4mal so lang wie breit. Beine in μm:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	276-333	305-371	124-143	52-57	33-38	24-29	38-43	0.38-0.41
P_2	381-429	352-381	190-210	86-95	48-52	29-29	38-48	0.53-0.57
P_3	295-343	386-436	190-218	67-76	29-38	24-29	38-38	0.49-0.54

Hypopygium etwa wie bei *C. edwardsi*, aber die Styli sind stärker gekrümmt.

Imago, ♀

Die Pigmentierung gleicht dem des Männchens, aber der Raum zwischen den Mesonotalbinden bleibt hell. 6. Antennenglied etwa so lang wie die 2 vorhergehenden zusammen. Palpen: 17–24, 22–24, 24–32 und 34–38 μm. Flügellänge 0,9–1,2 mm; Costa bzw. Clavus reichen etwa bis in die Mitte des Flügels; Beim Clavus R4+5 proximal deutlich von den vorderen Adern getrennt, die distale Hälfte vom Clavus ist geschlossen. Beine in μm:

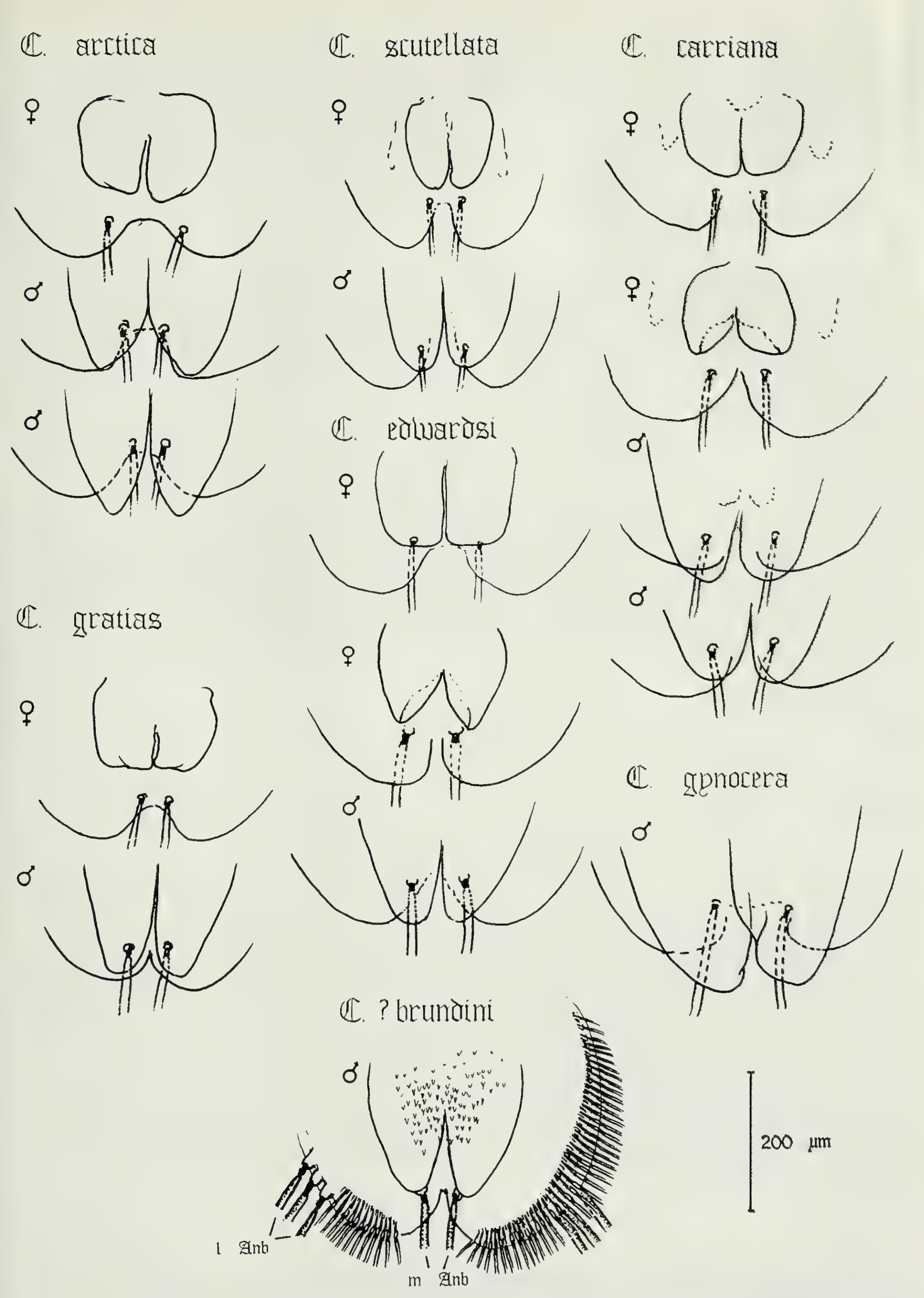


Fig. 8: Analenden von Puppenexuvien der *Corynoneura*-Arten der *edwardsi-*, *scutellata-* und *carriana*-Gruppe. 1 Anb = laterale Analborsten und m Anb = mediane Analborsten des Analsegments.

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	229-276	276-324	114-133	48-52	29-33	24-29	29-38	0.40-0.45
P_2	333-371	305-357	171-190	67-76	38-38	24-29	29-38	0.51-0.59
P_3	276-333	370-420	200-230	62-71	29-34	24-29	38-38	0.51-0.56

Spermatheken oval, etwa 70—100 μm lang.

Puppe

Material: Eine Puppenexuvie des Männchens liegt aus den Tümpeln, den sogenannten „Lompolos" in der Nähe des Sees Kilpisjärvi, Enontekiö, Finnisch-Lappland, 15.7.1969, B. Lindeberg leg., vor. Die Exuvie zeigt eine gewisse Ähnlichkeit mit der von *C. edwardsi*, läßt sich aber deutlich von dieser durch die Länge der Gonopodenscheiden unterscheiden. Weil in derselben Probe neben den Imagines von *C. brundini* auch solche von anderen *Corynoneura*-Arten vorhanden waren, ist die Zugehörigkeit nicht ganz gesichert. Aus der Typuslokalität liegt eine ähnliche Exuvie eines Weibchens vor, ihr fehlt das 9. Segment.

Exuvie etwa 1,3 mm lang. Nahtrand schmal, schwach spitzenartig gekörnelt und gerunzelt. Eine lange und deutliche und 4 kürzere und schwächer werdende Perlenreihen an den Flügelscheiden. Sternite 1 und 2 mit langen Spitzchen; am Medianteil von Sternit 1 scheinen die Anzahl und Länge der Spitzchen jedoch deutlich geringer als bei *C. edwardsi* zu sein. Chagrinierung der übrigen Abdominalsegmente etwa wie bei *C. edwardsi;* sehr kleine Chagrinierung wenigstens auf 3. Sternit, auch außerhalb der d-Borsten bis zum Lateralrand des Segments. Anzahl der intersegmentalen Dörnchen am Hinterrand der Sternite und Tergite 3—7, etwa 10 (8—14), am 2. Tergit nur 2—3. Gonopodenscheiden überragen nicht die Sockeln des medianen Analborstenpaares. Schwimmhaarsaum vom 9. Segment mit nahezu 40 Borsten.

Larve unbekannt.

Verbreitung

C. brundini lebt in Seen und Teichen in ganz Finnland.

Die Corynoneura carriana-Gruppe

SCHLEE (1968: Fig. 204) sieht in *C. carriana* besonders aufgrund der Strukturen des Hypopygiums eine Schwesterart von *C. edwardsi.* Ihre proximalen (?PV) Anhänge des Hypopygiums stellen jedoch nicht zwingend das Ergebnis derselben Entwicklungslinie dar. Vergleicht man die Flügel, so reicht bei *C. carriana* die Costa bzw. der Clavus (plesiomorph) weiter distal als bei allen hier behandelten Arten. Ferner hat *C. carriana* nach SCHLEE (1968: 30) die Borsten auf den Metatarsen gegenüber den anderen *Corynoneura*-Arten in 6 (nicht in 5) Längsreihen wie bei *Thienemaniella* angeordnet. Die (apomorphen) Antennen lassen sich von der Form ableiten, wie sie u. a. bei der *C. scutellata*- oder *C. edwardsi*-Gruppe oder bei „*Corynoneurella*" ausgebildet ist. Wegen der plesiomorphen Züge ist die *C. carriana*-Gruppe jedoch nicht von der *C. edwardsi*-Gruppe abzuleiten, noch weniger von der *C. scutellata*-Gruppe. Diese beiden können als die Schwestergruppen der *C. carriana*-Gruppe verstanden werden. *C. gynocera* ist leicht als eine apomorphe Schwesterart von *C. carriana* zu erkennen. Die *carriana*-Gruppe entspricht der Gruppe C bei EDWARDS (1928: 369). Ob diese Gruppe als eigene Untergattung *Paracorynoneura* Goetghebuer (1939: 7) anerkannt werden kann, wird sich erst klären lassen, wenn die zugehörigen Metamorphosestadien besser bekannt sind.

Diagnose

Imago:

Färbung ähnlich wie bei den Arten der vorhergehenden Artengruppen. Antenne beim ♂ höchstens 11gliedrig, 6gliedrig beim ♀. Länge der einzelnen Haare des Flagellums höchstens 100 μm (bei den anderen Artengruppen sind sie länger, bis etwa 200 μm). Das letzte Glied bei beiden Geschlechtern

apikal ohne Sensilla chaeticae, besonders beim ♂ spielkegelförmig. Im Proximalteil des letzten Gliedes keine oder sehr wenige normale Antennenborsten. Costa bzw. Clavus reichen bis zur Flügelmitte oder darüber hinaus; beim ♂ ist der Clavus wenigstens 4mal so lang wie breit. Beim Hypopygium sind die proximalen Anhänge kurz, apikal nicht spitz. Stylus einfach. Medianteil des Sternapodems X stark reduziert mit lateral gerichtetem Gelenkzapfen für das Penisapodem; letzteres lang und stark gebogen.

Puppe nur schwer von der der *C. scutellata*-Gruppe zu unterscheiden. Lange Spitzchen kommen auf 2. Sternit und sehr winzige auf 1. Sternit vor.

Larve unbekannt.

Corynoneura carriana Edwards (1924: 188–189, ♂, ♀)

Als eventuelle Synonyme von *C. carriana* geben Edwards (1929: 369) und Goetghebuer (1939: 7) folgende Arten an:

C. acuticornis Kieffer (1912: 101–102, ♀)
C. heterocera Kieffer (1915: 87, ♂)
C. crassipes Kieffer (1925: 564, ♂)

C. acuticornis könnte wegen der Flügeladerung mit *C. carriana* artidentisch sein.

C. heterocera hat nach Edwards (1924: 189) ähnliche Antennen aber die Flügel sind verkürzt. Weil die Antennen nach der Originalbeschreibung ohne Federbusch sind, hat Goetghebuer (1939: 7. 11) *C. heterocera* vermutlich nicht synonymisiert. Goetghebuer faßt jedoch *C. crassipes* als ein Synonym auf. Die beiden letztgenannten Arten sind wegen des Baues der Antennen und der Palpen sehr wahrscheinlich Synonyme von *C. carriana*. Eine weitere Art, die nach der Originalbeschreibung eine 11gliedrige Antenne mit kurzem Haarbusch besitzt, ist *C. marina* Kieffer (1923: 43, ♂, ♀).

Alle vier hier aufgeführten Arten werden vorerst als *nomina dubia* betrachtet und nicht als Synonyme zu *C. carriana* gestellt, bis ihre genaue Zuordnung an Originalmaterial geprüft worden ist.

Typusmaterial von *C. carriana* befindet sich im British Museum, London. Es wurde verzichtet Originalmaterial zu überprüfen, da die Zuordnung des finnischen Materials sicher erscheint.

Material: 3 ♂ und 2 ♀ aus dem Brackwasser bei Tvärminne, Brännskär, Juni/Juli 1963, Elina Hirvenoja leg., 1 ♂ aus Tvärminne, Jovskär, 27.7.1971, B. Lindeberg leg. und 1 ♂ aus einem Torfstich, Riihimäki, 1.7.1956, M. Hirvenoja leg. Die Exemplare aus Riihimäki sind deutlich kleiner als die aus dem Brackwasser.

Imago, ♂

Antenne 11gliedrig; Apikalglied etwa so lang wie die 3–4 vorhergehenden zusammen, bisweilen mit einigen normalen Antennenborsten im Proximalteil; die längsten von den locker sitzenden Federbuschborsten etwa 100 μm; AR 0,37–0,45. Palpenglieder: 18–22, 22–24, 24–33 und 34–46 μm. Flügellänge 0,7–1,1 mm; Clavus etwa 4mal so lang wie breit. Beine in μm:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	258-325	289-356	144-182	71-89	40-52	18-22	31-40	0.47-0.52
P_2	338-409	307-383	169-182	71-89	37-45	18-22	35-40	0.48-0.55
P_3	289-365	280-352	151-182	89-107	36-37	18-22	35-35	0.50-0.57

Hypopygium wie in Fig. 2.

Imago, ♀

Bei typischen Exemplaren etwa das apikale Viertel des letzten Antennengliedes ohne Sensilla chaeticae; Palpenglieder: 15–18, 18–22, 20–23 und 39–42 μm. Flügellänge 1,1–1,3 mm; Clavus reicht über die Mitte des Flügels, die einzelnen Adern stark verschmolzen. Beine in μm:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	285-303	338-343	160-173	71-84	40-49	20-22	40-40	0.47-0.51
P_2	365-405	351-378	191-196	80-80	36-40	22-27	36-40	0.52-0.54
P_3	347-365	329-356	178-187	89-90	36-36	20-20	36-45	0.53-0.54

Spermatheken 80—90 μm lang; vor dem Ductus charakteristisch gekrümmt und etwas verjüngt.

Puppe

Material: Tvärminne

Exuvie 2,0—2,4 mm (n = 3) lang. Nahtrand oral schmal, schwach gekörnelt oder gerunzelt. Apex der Flügelscheiden mit 2—3 kurzen Perlenreihen. Auf 1. Tergit bisweilen einige Dörnchen und auf

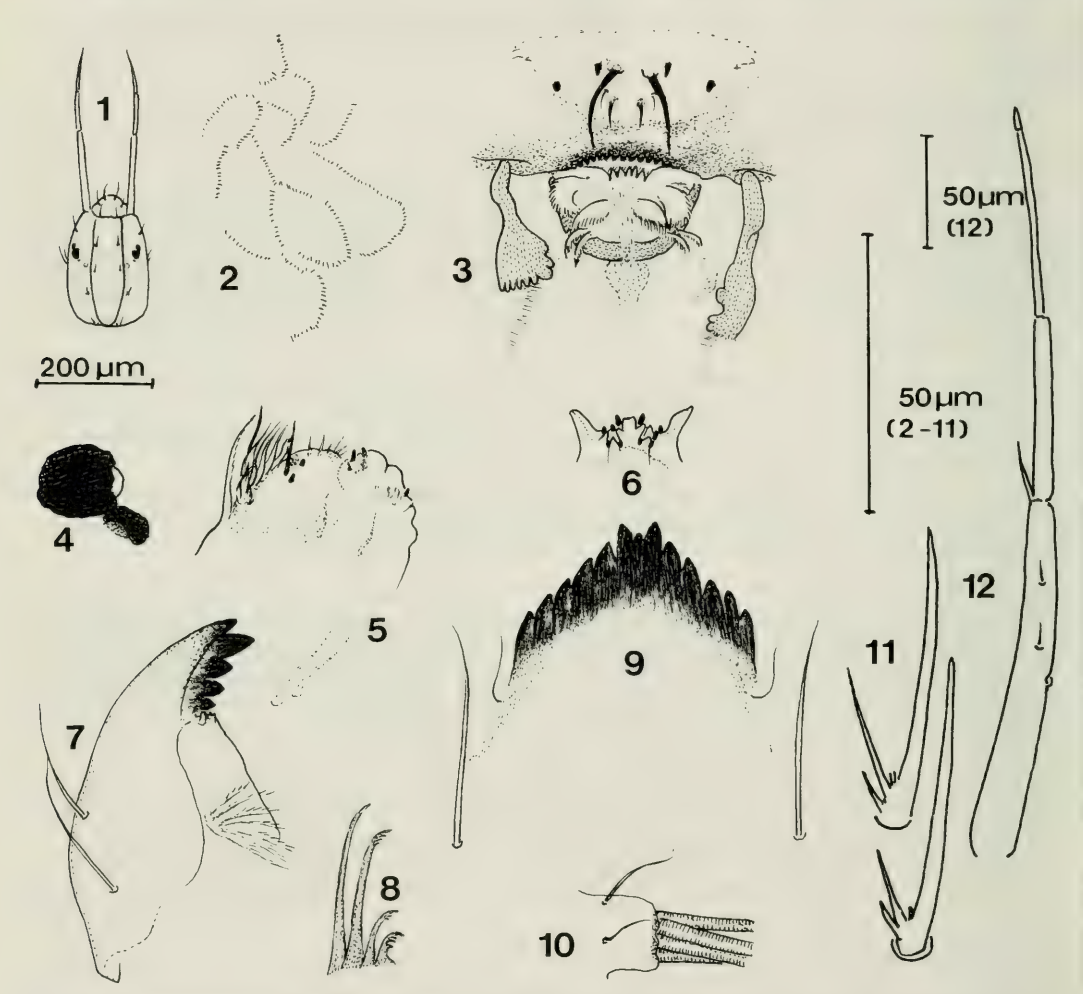


Fig. 9: *Corynoneura scutellata* Winn., Larve: 1 Kopf; 2 Skulptur des Kopfes; 3 Sinnesfeld des Labrums, Epipharynx und Praemandibeln. 4 Augen; 5 Maxille; 6 Praementum; 7 Mandibel; 8 Klauen der Vorderfüße; 9 Zahnleiste der Labialregion nebst ventralen Borsten von Postgena; 10 Praeanale Borstenträger (Procerci); 11 Ventralborsten des 10. Abdominalsegments; 12 Antenne.

1. Sternit an den oral-lateralen Ecken sehr kleine Spitzchen. Chagrinierung normal, nicht sehr breit, beginnt auf 2. Segment. 2. Sternit mit langen Spitzchen. Intersegmentale Dörnchen dorsal und ventral auf den Hinterrändern des 3.–7. Segments, einige bisweilen auf 2. Tergit, meist etwa 10 (6–16). Gonopodenscheiden reichen etwa bis zum Hinterrand des Analsegments; beim ♂ enden die Scheiden der Cerci deutlich vor den Sockeln der medianen Analborsten. Analer Schwimmhaarsaum mit etwa 32–55 Borsten.

Larve unbekannt.

Verbreitung

C. carriana ist in Finnland bisher etwa bis zum 62° N Breitengrad angetroffen worden. Die Angaben von Tuiskunen & Lindeberg 1986: 366, über *C. carriana* in Lappland, beziehen sich auf *C. brundini* spec. nov.

Corynoneura gynocera Tuiskunen (1983: ♂, Puppe).

Typusmaterial Coll. Zoologisches Museum der Universität Helsinki, Finnland.

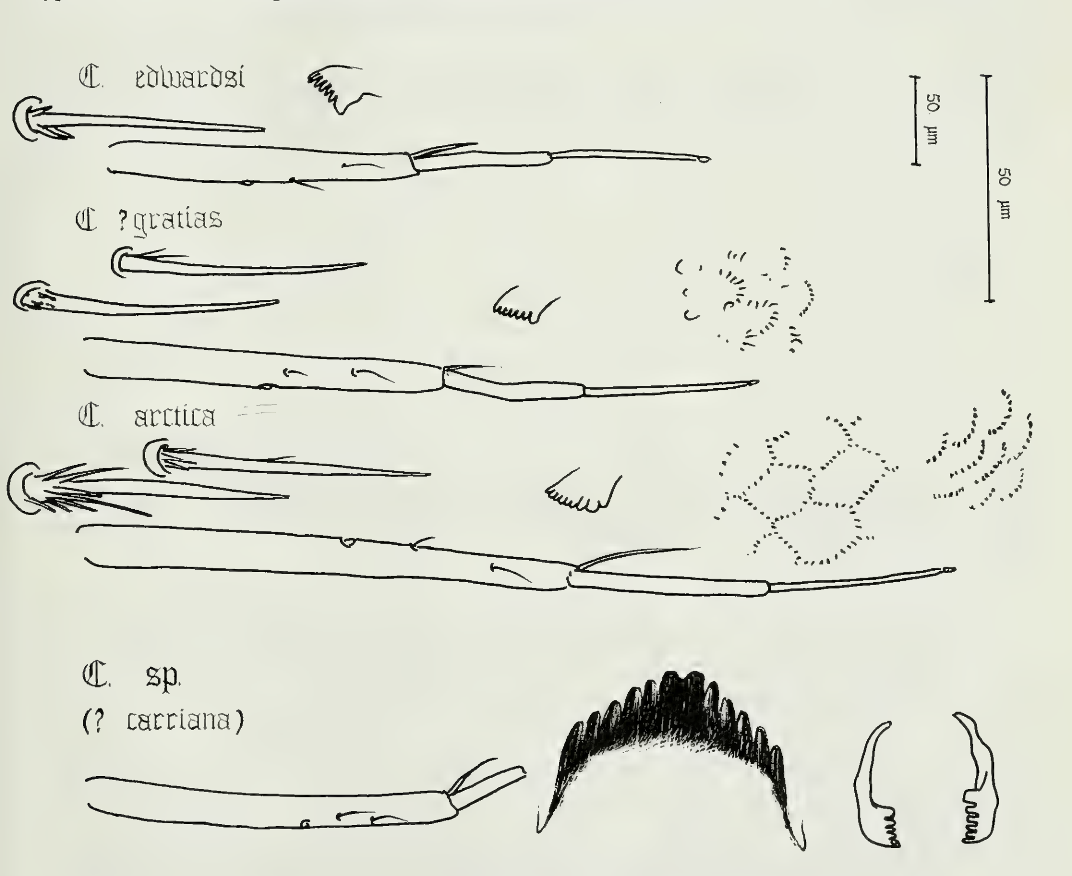


Fig. 10: *Corynoneura* spec., Larve: Antennen, Ventralborsten von Abdominalsegment 10, Apikalteile der Praemandibeln nebst Skulpturen der Larvenköpfe von *C. edwardsi* Brundin, der vermuteten Larve von *C. gratias* Schlee (mag die individuelle Variation von *C. edwardsi* repräsentieren!) und *C. arctica* Kieff. Ferner Teile (die Antenne abgebrochen) eines Larvenkopfes aus einem Brackwasserbiotop bei Tvärminne, wo u. a. *C. carriana* Edw. angetroffen wurde.

Imago, ♂

Es ist nur das ♂ mit der eigentümlichen 7gliedrigen Antenne (Pedicellus mitgezählt) bekannt; AR (nach Tuiskunen) 0,58–0,72. Ergänzungen zur Originalbeschreibung: Palpen (Holotypus): 20, 28, 36 und 45 μm. Die Flügel zeigen die ursprünglichste Gestalt der hier behandelten Arten; der Clavus reicht deutlich über die Flügelmitte und ist etwa 6mal so lang wie die größte Breite.

Beine (Holotypus) in μm:

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR (nach Tuiskunen)
P_1	312	347	169	88	49	22	40	0.47-0.53
P_2	383	347	178	80	45	27	45	0.47-0.52
P_3	338	342	178	98	45	27	45	0.47-0.53

Das Hypopygium weist eine bemerkenswerte Struktur auf. Ein geschlossenes Sklerit scheint einen Annulus um das Analsegment zu bilden. Penisapodem verhältnismäßig kurz, etwa wie bei *C. gratias*, aber sein Gelenkzapfen im X. Sternapodem ist stärker lateral gerichtet.

Puppe

Ergänzungen und Korrekturen zur Originalbeschreibung: Besonders an den oral-lateralen Ecken vom 1. Sternit winzige Spitzchen, auf Sternit 2 sind diese lang und deutlich. Die dorsale Chagrinierung fängt auf dem 3. Tergit an; an den Hinterrändern der Segmente dorsal und ventral mit etwa 10 (8–12) größere Dörnchen in jeder Reihe (n = 10).

Larve unbekannt.

Verbreitung

Die Art ist nur von der Fundlokalität in Finnisch-Lappland bekannt.

Bestimmungstabellen

Die hier behandelten Arten bzw. Artengruppen werden als eine monophyletische Einheit aufgefaßt. Dieser Artenkomplex repräsentiert zum Teil *Corynoneura* s. str. und *Paracorynoneura* im Sinne von GOETGHEBUER (1939). Bei ihnen ist das Apikalende der Hintertibien stark angeschwollen. Das Apikalglied der Antennen hat beim ♂ entweder eine spielkegelförmige Gestalt und ist apikal ohne Sensilla chaeticae, oder es bleibt terminal verschmälert und ist distal der subapikalen Verdickung mit Sensillae besetzt.

♂♂.

1 (4) Der apikale Teil des spielkegelförmigen (Fig. 4) letzten Antennengliedes wenigstens auf 1/4 der Länge ohne Sensilla chaeticae: Apikalglied etwa so lang wie die 3–4 vorhergehenden Glieder zusammen; Behaarung der Flagellomeren kurz . . . . *Corynoneura carriana*-Gruppe 2

2 (3) Antenne 11gliedrig . . . . *C. carriana* Edw.

3 (2) Antenne 7gliedrig . . . . *C. gynocera* Tuisk.

4 (1) Apikalglied der Antenne anders (Fig. 4) geformt, distal von der Verdickung breit mit Sensilla chaeticae und proximal mit vielen langen Antennenborsten besetzt (= normaler Haarbusch) 5

5 (10) Stylus mit einer hyalinen, lobusähnlichen Crista dorsalis. Proximale (?PV) Anhänge der Gonocoxite reichen in die Mitte der Gonocoxite. Apikalglied der Antennen nahezu so lang wie die übrigen Flagellomeren zusammen. . . . . *Corynoneura*-Gruppe 6

6 (7) Gelenkzapfen des Penisapodems im Sternapodem X ventral gerichtet. Vorletztes Palpenglied kaum länger als die ersten freien, kugeligen Glieder .... *C. gratias* Schlee

7 (6) Gelenkzapfen des Penisapodems im Sternapodem X lateral gerichtet. Vorletztes Palpenglied nahezu zweimal länger als breit 8

8 (9) An der distalen Hälfte der Gonocoxite ein sehr kleiner Lobus. Apikalborste (A) der Hintertibien steht senkrecht zur Längsachse von Ti, kurz S-förmig (Fig. 6) .... *C. scutellata* Winn.

9 (8) Gonocoxite ohne Lobus. Apikalborste (A) nicht S-förmig, zwar etwas gekrümmt, aber deutlich im spitzen Winkel zur Tibiallängsachse stehend .... *C. arctica* Kieff.

10 (5) Crista dorsalis nicht wie ein Lobus, sondern eine mehr oder weniger deutlich längere Leiste. Die proximalen Anhänge (?PV) der Gonocoxite kurz, distal ziemlich spitz. Apikalglied der Antennen höchstens so lang wie die 8 vorhergehenden Flagellomeren zusammen .... *Corynoneura edwardsi*-Gruppe 11

11 (12) AR > 0.6; Apikalglied so lang wie die 6–8 Flagellomeren zusammen. Das letzte Palpenglied länger als die Summe der zwei ersten freien Glieder ...... *C. edwardsi* Brund.

12 (11) AR < 0.5; Apikalglied so lang wie die 3–3.5 vorhergehenden zusammen. Das letzte Palpenglied nicht länger als die beiden ersten freien Glieder zusammen .... *C. brundini* spec. nov.

♀♀. (Das Weibchen von *C. gynocera* ist unbekannt).

1 (2) Antenne apikal ohne Sensilla chaeticae. Das dritte Palpenglied kaum länger als die zwei ersten kugeligen Glieder zusammen. Spermatheken proximal verschmälert, gekrümmt (Fig. S. 4, 5, 7) .... *C. carriana* Edw.

2 (1) Wenigstens die distale Hälfte des Apikalgliedes der Antennen mit Sensilla chaeticae .. 3

3 (4) Apikalborste (A) von Ti/P_3 kurz S-förmig und etwa senkrecht zur Längsachse der Tibia stehend .... *C. scutellata* Winn.

4 (3) Apikalborste (A) von Ti/P_3 etwas gekrümmt, aber niemals senkrecht zur Längsachse der Tibia stehend 5

5 (6) $LR/P_1 < 0.45$. Das letzte Palpenglied kürzer als die zwei vorhergehenden zusammen ... . *C. brundini* spec. nov.

6 (5) $LR/P_1 > 0.45$ 7

7 (8) Letztes Palpenglied etwa ebenso lang wie die beiden rundlichen vorhergehenden Glieder zusammen (Fig. 5) LR/P_1 etwa (?) 0.55; bei P_3 das Verhältnis $Ta_2 : Ta_3$ 2.2 .... *C. gratias* Schlee

8 (7) Letztes Palpenglied etwas länger als die beiden vorhergehenden zusammen. Auf P_3 $Ta_2 : Ta_3 > 2.3$ 9

9 (10) LR/P_1 etwa 0.55. Drittes freies Palpenglied weniger als zweimal so lang wie breit. Clavus wenigstens auf der distalen Hälfte mit völlig verschmolzenen Adern. Spermatheken etwa 75–80 μm lang .... *C. arctica* Kieff.

10 (9) LR/P_1 ungefähr 0.50. Drittes freies Palpenglied etwa zweimal so lang wie breit. Clavus wenigstens im distalen Drittel mit verschmolzenen Adern, im proximalen Teil ist R 4+5 deutlich von den vorderen Adern zu trennen. Spermatheken größer (80–100 μm) .... *C. edwardsi* Brund.

Puppe

Die weiblichen Puppen von *C. gynocera* und *C. brundini* sind unbekannt. Die Tabelle ist nur als ein Versuch anzusehen, da das vorliegende Material unzureichend ist.

1 (7) Mehr oder weniger lange, farblose Spitzchen auf dem 1. und 2. Sternit, die meisten von ihnen mehrmals länger als breit 2

2 (3) Lange Spitzchen auf der ganzen Fläche der Sterniten 1 und 2. Gonopodenscheiden reichen etwa bis zum Hinterrand des Analsegments. Scheiden der Cerci reichen etwa bis zu den Sockeln der medianen Analborsten . . . . *C. edwardsi* Brund.

3 (2) Spitzchen in der Mitte des 1. Sternits, wenn vorhanden, sehr klein, stets viel kleiner als an den Lateralteilen 4

4 (5) Gonopodenscheiden reichen bis an die Sockel der medianen Analborsten . . . . ? *C. brundini* spec. nov.

5 (4) Gonopodenscheiden reichen bis zum Hinterrand des Analsegments oder darüber hinaus . . . . *C. arctica* Kieff.

7 (1) Segment 1 ohne dorsale und ventrale Chagrinierung oder, wenn vorhanden, mit winzigen Spitzchen oder Dörnchen, die höchstens 2mal so lang wie breit sind. Eine sichere Bestimmung der Weibchen ist schwierig, oder nicht möglich 8

8 (13) Winzige Dörnchen bis zum Lateralrand der Exuvie auf den Sterniten 3–5 (6) 9

9 (10) Gonopodenscheiden auffallend groß, überragen den Hinterrand des Analsegments sehr deutlich. Antennenscheiden des ♂ ungewöhnlich kurz (etwa 200 µm). Auf Tergit 2 sehr wenige Dörnchen. Flügelscheiden mit vielen deutlichen Perlenreihen . . . . *C. gynocera* Tuisk.

10 (9) Gonopodenscheiden kürzer. Antennenscheiden des ♂ 300–500 µm lang 11

11 (12) Gonopodenscheiden mit parallelen Seiten, enden auf der Mitte zwischen dem Hinterrand des Analsegments und den Sockeln der medianen Analborsten. Flügelscheiden mit wenigen Perlenreihen, bisweilen schwer zu erkennen. Am Hinterrand des 2. Segments fehlen oft die großen Dörnchen. Antennenscheiden des ♂ etwa 400–500 µm lang . . . . *C. scutellata* Winn.

12 (11) Gonopodenscheiden schwach konisch, reichen etwa bis zum Hinterrand des Analsegments. Am Hinterrand des 2. Segments oft große Dörnchen. Perlenreihen stets deutlich erkennbar. Antennenscheiden des ♂ etwa 300–400 µm lang . . *C. carriana* Edw.

13 (8) Chagrinierung verhältnismäßig spärlich, reicht lateral oft nicht über die Dorsalborsten hinaus. Gonopodenscheiden reichen kaum bis zum Hinterrand des Analsegments . . . . *C. gratias* Schlee

Larven

Die Tabelle ist nur als ein Versuch anzusehen, da das vorliegende Material zu unvollständig ist. Es sei darauf hingewiesen, daß sich die Antenne vom ersten bis letzten Larvenstadium verlängert. Bei den *Corynoneura*-Arten scheinen darüber hinaus auch Längenunterschiede zwischen den Arten gegeben zu sein. Die längsten Antennen besitzt *C. celeripes* Winn. (sensu Edwards nec. Schlee), sie sind etwa 2,5mal so lang ist wie der Kopf.

1 (8) Zahnleiste der Labialregion mit einem sehr kleinen unpaarigen Medianzahn zwischen den etwa gleichgroßen Lateralzähnen 2

2 (3) Antenne bis etwa 330–350 µm lang, höchstens so lang wie der Kopf. Kopf schwach skulpturiert . . . . *C. edwardsi* Brundin.

3 (2) Antenne länger als der Kopf 4

4 (7) Antenne etwa 1/4 länger als der Kopf 5

5 (6) Antenne etwa 370–390 μm lang. Kopf schwach und unregelmäßig skulpturiert .... *C. gratias* Schlee

6 (5) Antenne etwa 340–450 μm lang. Der Kopf meist schwach und netzartig skulpturiert .... *C. scutellata* Winn.

7 (4) Antenne bis 495–560 μm lang, etwa um halbe Kopflänge länger als der Kopf. Kopf deutlich netzartig skulpturiert .... *C. arctica* Kieff.

8 (1) Der Medianzahn der Zahnleiste der Labialregion reduziert (Fig. 10) .... *Corynoneura* spec. (? *C. carriana* Edw.)

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A Review of the Genus Polypedilum Kieffer The cytotaxonomy of Polypedilum aberrans Tshernovskji

(Diptera, Chironomidae)

By **Paraskeva Vl. Michailova**

Abstract

The male, female and pupa of *Polypedilum aberrans* Tshernovskji are described for the first time. The species is characterised cytotaxonomically. The banding patterns of the polytene chromosomes of *P. aberrans* and *P. nubifer* are compared. Analysis of the banding pattern indicates that the relationships of these species are close. Sequences in arms A, E, and F are apparently quite ancient, probably ancestral, because of their occurence in *P. nubifer* (A_1/A_1; E_3/E_3; F_1/F_1) *P. nubeculosum*, and *P. aberrans*. The species is female heterogametic. The females always being heterozygous for the differential heterochromatic end on chromosome IV. The two species: *P. aberrans* and *P. nubifer* are very similar but are readily distinguishable by the hypopygium of the males and by their cytology.

Introduction

Polypedilum aberrans Tshernovskji is a species known through a larva described by Tshernovskyi (1949). Pinder & Reiss (1983) considered this species as a synonym of *Polypedilum nubifer* (Skuse). The two species have alternate Lauterborn organs on the larval antenna.

The imago (♂) of *P. nubifer* has been reviewed by Freeman (1961), and the cytology has been described by Porter & Martin (1977). *P. nubifer* has been recorded from North Africa, Iraq, Sri Lanka and Australia (Freeman, 1961).

A description of the imago and pupa of *P. aberrans* does not exist. Marker features of the chromosomes of this species have been given by Michailova (in press). Pankratova (1983) reviewed the larva of this species and presented its known distribution: USSR, Bulgaria and Hungary.

The purpose of the present paper is to describe the adult and pupa stages of *P. aberrans* from material reared in the laboratory; to characterise this species cytotaxonomically and to show that the immature stages and cytology serve to separate *P. aberrans* and *P. nubifer.* They are readily recognisable species. The karyotypic relationships between these species is also indicated.

Material and methods

Larval material of *P. aberrans* was collected in lake Durankulak, VII. 1979. Specimens of this species from Hungary, collected in Kondor-tö VII. 1983 and VIII. 1986, were also studied. In the laboratory larvae grow to maturity in about 3–4 weeks. Laboratory reared adults were used for keeping a stock of this species. The crossing of adult midges was made by a method described earlier (Michailova, 1985).

18 specimens (10 ♂♂ and 8 ♀♀), 5 pupae and 35 larvae have been examined. Adults were fixed in 70% alcohol and the preparations made according to Schlee (1966). Larvae were fixed in 3:1 ethanolacetic acid and stored in a deep freeze. The general terminology follows Saether (1980).

Karyological preparations of salivary glands and gonads of IVth instar larvae (35 specimens: 5 from Durankulak and 30 from Kondor-tö) were prepared applying the well known acetorcein method. After analysis the slides were made permanent by freezing in liquid nitrogen, to enable removal of the cover glass, and mounting in euparal.

The chromosomes of *P. nubifer* have been proposed as a standard for the comparative cytotaxonomy of the genus *Polypedilum* (PORTER & MARTIN, 1977).

Following the homology with the chromosomes of this standard, the chromosomes of *P. aberrans* were designated as: Ist(AB), IInd (CD), IIIrd(EF) and IVth(G). Every chromosome has been divided into sections, beginning from 1 in the left arm of every chromosome. This division is not the same as that of *P. nubifer*, done by PORTER & MARTIN (1977) (a photo map of each arm of *P. nubifer* was not given). The common sections of the chromosomes between these species have been shown in outline in the text.

External morphology of Polypedilum aberrans
(Figs. 1, 2)

Imago: ♂

Colour: Thorax and abdomen dark brown, legs, light brown.

Thorax: Antepronotal and dorsocentral lobes well formed, dark brown, about 35 dorsocentral setae in 2 rows. Scutellum dark brown with 20 setae in two rows. Postnotum brown.

Legs: With middle and hind tibial combs, each with one spur (Fig. 1 A). Legs proportions: (μm, n = 5).

	F	T	T_{a_1}	T_{a_2}	T_{a_3}	T_{a_4}	T_{a_5}
P_1	485	425	480	275	255	180	105
P_2	550	440	300	160	130	85	75
P_3	600	515	400	135	190	115	90

Hypopygium: (Fig. 1 B). Gonocoxite consists of two parts, distal part is as long as wide. Gonostylus 2× as long as wide. Volsella apically curved. Anal point is straight from the very beginning. Anal field oval. Coxpodeme well developed. Phallapodeme rod-like.

Imago: ♀

Colour: light brown

Genitalia. (Fig. 1 C). Gonosternite oval, with long setae and darkly coloured edges. Gonapophysis IX well formed, reaches almost the middle of SVIII. Coxosternapodeme dark, dense and arched.

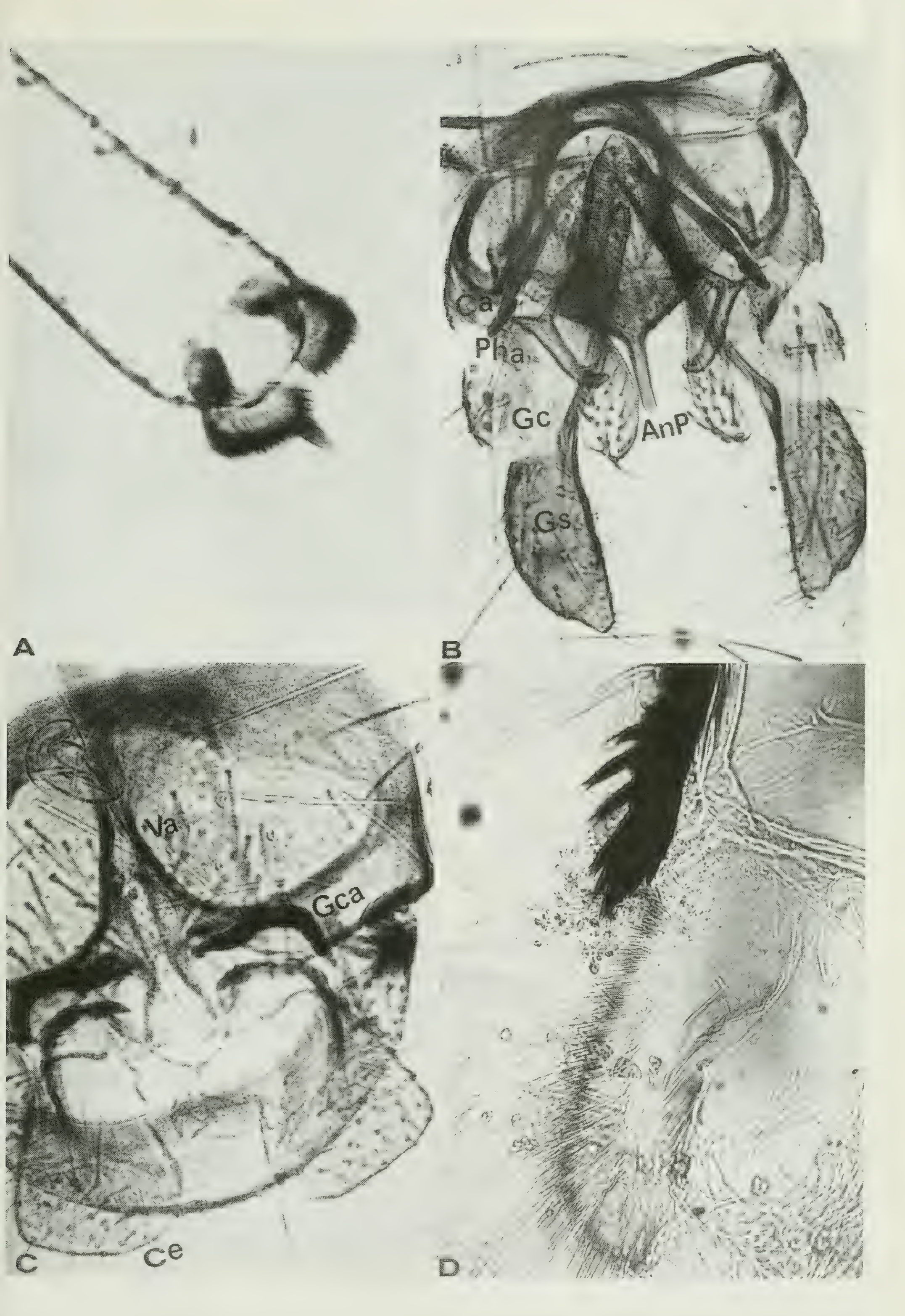
Pupa:

Exuvia light brown. 2. segment in a lower part with a row of setae. 3.–7. segments with a group of setae in an upper and lower part. Posterolateral spurs of segment 8. with 8 or 9 spines (Fig. 1 D).

Larva: (Fig. 2 A, B, C).

Antenna, labrum, mandible and premandible as in TSHERNOVSKJI (1949, fig. 47) and PANKRATOVA (1983, fig. 201).

Fig. 1. *Polypedilum aberrans.* A, Hind leg with comb and spur. B, Hypopygium; Ca – coxapodeme; Pha – phallapodeme; AnP – anal point; Gc – gonocoxite; Gs – gonostylus. C, Genitalia (♀); Gca – Gonocoxapodeme; Va – vaginal apodeme; Ce – cercus. D, Pupa: 8. segment, posterolateral spur with 8 spines.


Ca
Pha
Gc
AnP
Gs
A
B
Va
Gca
C
Ce
D

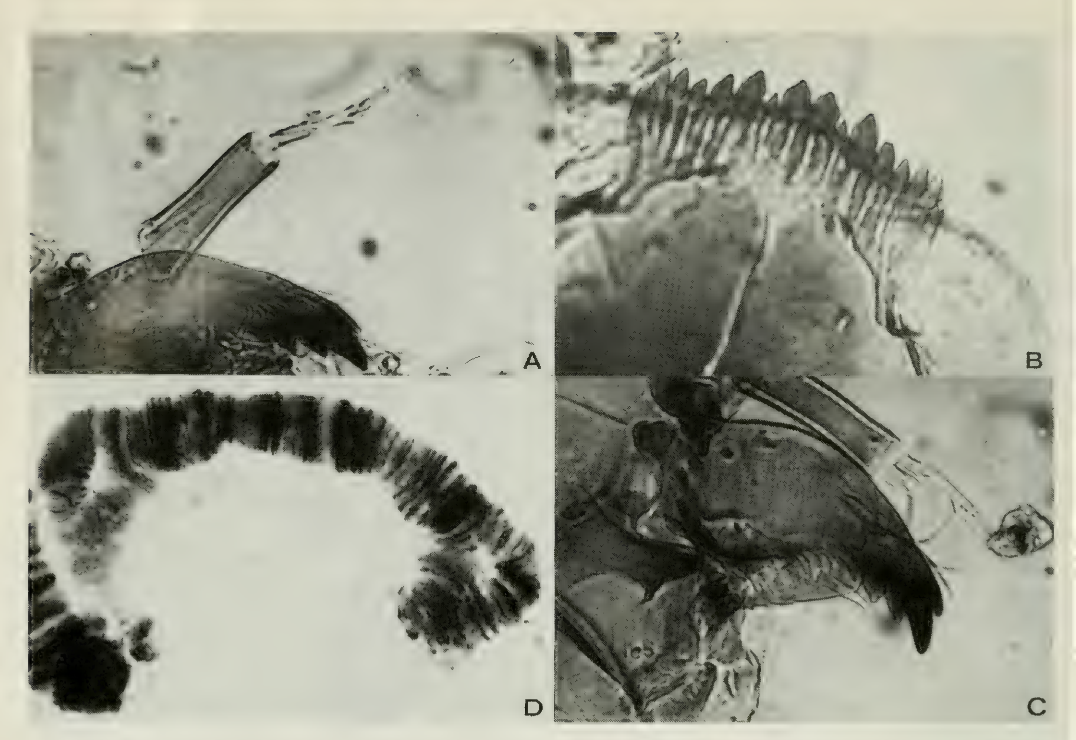


Fig. 2. *Polypedilum aberrans.* A, Antenna. B, Labrum. C, Mandible. D, Heterozygous inversion in arm B.

The karyotype of Polypedilum aberrans

(Fig. 3 A, B, C, D)

2n = 8. Chromosome I (AB), and II (CD), Ist (AB), IInd (CD) chromosomes – metacentric; Chromosome III (EF) – submetacentric and IV (G) – acrocentric. Every chromosome with a dark heterochromatin band in the centromere region. Sex chromosomes were not found. The species is female heterogametic. The females always being heterozygous for the heterochromatic end on the chromosome IV.

Chromosome polymorphism has been observed only in arm B of Ist chromosome.

The chromosome markers have been described by Michailova (in press).

Chromosome I with arms AB similar to its counterpart in *P. nubifer.* Porter & Martin (1977) reported five rearrangements in arm A. Only two of them are in homozygous condition. *P. aberrans* has only one type of band sequence. Part of which coincides with that of *P. nubifer* (A_1/A_1) and part – with A_2/A_2.

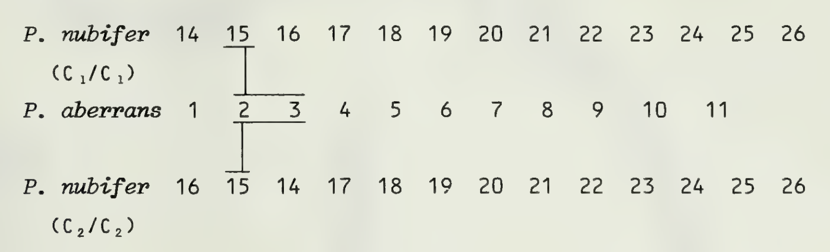
Chromosome I

P. nubifer (A_1/A_1)	1	2	3	4	5	6	7	8	9	10	11	12	13
P. aberrans	1	2	3	4	5	6	7	8	9	10	11	12	13
P. nubifer (A_2/A_2)	1	4	3	2	5	6	7	8	9	10	11	12	13

Arm B of *P. nubifer* has four rearrangements in heterozygous condition (Porter & Martin, 1977) on both populations of *P. aberrans,* we found only one type of heterozygous inversion with a very low frequency (Fig. 2D).

Chromosome II, with arms CD showing considerable change from the sequences seen in *P. nubifer.* Three rearrangements have been recognized in arm C of *P. nubifer* (Porter & Martin, 1977). In arm C of *P. aberrans* only one type of band sequence was found. The two groups of dark bands in section 2–3 of *P. aberrans* exist in *P. nubifer,* described by Porter & Martin (1977) as C_1/C_1 and C_2/C_2. The other sequences of *P. aberrans* must have changed considerably in appearance compared with the standard. Arm C shows a sequence not previously reported.

Chromosome II



Arm D is considerably changed in *P. aberrans.*

Chromosome III, with arms EF. There are four rearrangements in arm E of *P. nubifer* (Porter & Martin, 1977). All have been seen in the homozygous condition. In *P. aberrans* only one type of band sequence was seen in which the banding pattern on section 1–6 is very similar to that of E_3/E_3 of *P. nubifer.* The bands after this sequence appear to differ from that of P. nubifer.

There were four rearrangements in arm F of *P. nubifer* (Porter & Martin, 1977). Two of them have been seen in the homozygous conditions. Arm F of *P. aberrans* has only one type of sequence. Section 9–11 of *P. aberrans* is identical to F_1/F_1 described by Porter & Martin (1977) for *P. nubifer.*

Chromosome III

P. nubifer 27 30 29 28 27
(E_3/E_3)
P. aberrans 1 2 3 4 5 6 7

P. nubifer 31 32 33 34 35 36
(F_1/F_1)
P. aberrans 8 9 10 11

Chromosome IV, or arm G, appears similar to *P. nubifer.* When a detailed analysis of the chromosome is attempted the bands in section 4 of *P. aberrans* can be positively correlated with those in the middle of *P. nubifer.*

Chromosome IV

P. nubifer 37 38 39 40 41

P. aberrans 1 2 3 4 5 6

Porter & Martin (1977) reported six rearrangements in arm G of *P. nubifer.* In *P. aberrans* there are only two types of sequences which are in one and the same salivary gland. These differ in their functional activity.

P. aberrans is female heterozygous for a heterochromatic end (Fig. 3 D, G_2), while males are homozygous for this. The female rearrangements are similar to G_2/G_2 of *P. nubifer.*



Fig. 3. *Polypedilum aberrans.* A, Chromosome Ist (AB). B, Chromosome IInd (CD). C, Chromosome IIIrd (EF). D, Chromosome IVth (G_1 or G_2); N – nucleolus; BR – Balbiani ring; c – centromere region.

Discussion

Detailed study of adults of *P. nubifer* and *P. aberrans* indicated that there are two different species. These species are very similar but are readily distinguishable by the male hypopygium. The coxite of *P. nubifer* consists of two parts. The second part is strongly prolongated (Freeman, 1961). The second part of coxite of *P. aberrans* is as long as wide. Between these parts in *P. aberrans* there is a well formed concavity (Fig. 1B). Such a concavity is not seen in *P. nubifer* (Freeman, 1961). The volsella of *P. aberrans* is terminally recurved (Fig. 1B). The hypopygium of *P. aberrans* differs from that of *P. nubifer* by having broader gonostyli while the gonostyli of *P. nubifer* are more slender (Freeman, 1961). The two species differ in the shape of the anal point. That of *P. nubifer* is narrower basally while the anal point of *P. aberrans* is straight from base to apex (Fig. 1B).

Cytogenetical investigations of material which keys out as *P. nubifer* (Porter & Martin, 1977) and *P. aberrans* revealed the existence of two readly recognisable species with four chromosomes in the salivery gland. The banding patterns of *P. aberrans* and *P. nubifer* also indicate a close relationship. The salivary gland chromosomes of *P. aberrans* show sufficient similarity in banding pattern to those of *P. nubifer,* mainly in arms A, E, and F. In the genus *Polypedilum* as in the genus *Chironomus* arms A, E, and F seem to have been more stable in evolution. Arms B, C, D, and G as we have seen show more differences between the species. However within the arms it is not yet possible to suggest homology of more than a few of the most conspicious band groups. Every species has marker features on each chromosome. Some sequences differ between these species by a simple inversion.

There is no cytological evidence and external morphological data to support the suggestion that *P. aberrans* should be considered as a synonym of *P. nubifer.*

In the present case a few species of *Polypedilum* have been studied cytologically: *P. nubifer* (Porter & Martin, 1977), *P. aberrans, P. nubeculosum* and *Polypedilum* sp. (Chironominae genuinae N3 Lipina) (Michailova, in press). This allows determination of the relative age of some sequences. Phylogenetically central sequences with wide distribution are more ancient than sequences with restricted distribution. With the exception of the G chromosome, the other chromosomes of *P. aberrans* and *P. nubeculosum* have only one type of band sequence. Porter & Martin (1977) reported few rearrangements for arms A, C, E, F, G of *P. nubifer.* One of them is common for *P. nubifer, P. aberrans* and *P. nubeculosum.* The banding pattern of *P. aberrans* arm A, section 2–5 and the banding pattern of the same arm of *P. nubifer,* section 2–4 a 9 (A_1/A_1) are common for the species. In arm C there are also common patterns: bands in section 2–3 of *P. aberrans* and 15 (C_1/C_1 or C_2/C_2) of *P. nubifer.* The banding pattern of arm E of *P. aberrans,* section 2–6 corresponds with that of *P. nubifer,* section 27–30–27al (E_3/E_3). Arm F: the banding pattern, section 9–11 *(P. aberrans)* and section 33 c 9–36 b 12 *(P. nubifer)* is common for both species. The banding pattern ($_4$) of arm G *(P. aberrans)* and that in the middle of arm G *(P. nubifer)* are common.

These band sequences have been found in *P. nubeculosum* also (Michailova, in press). These patterns could be considered as "basic patterns" of genus *Polypedilum* in sense of Wülker (1980). Perhaps these common patterns existed in a hypothetical stem species. Starting from the hypothetical species these patterns have been retained in one species but in an other *(P. nubifer)* have undergone different mutations. On that way *P. nubifer* displays a high frequency of chromosomal rearrangements. There is an other explanations also: the common ancestor was polymorphic for a number of sequences which still occur as polymorphism only on *P. nubifer.*

Porter & Martin (1977) reported a female heterogamety of *P. nubifer.* They have also found heterozygous males. A more likely explanations is that the species is still in the process of changing from the normal male heterogamety to female heterogamety (Porter & Martin, 1977). In *P. aberrans* this process is going forward. Only females always carry the large heterochromatinized differential segment.

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Schineriella schineri gen. nov., comb. nov., placement of Tanypus schineri Strobl 1880

(Diptera: Chironomidae)

By **D. A. Murray** and **E. J. Fittkau**

Abstract

The new genus *Schineriella* is erected for the species *Tanypus schineri* Strobl 1880. Diagnoses for the adult male and pupa are given. The type species is, by monotypy, *Schineriella schineri* (Strobl).

Introduction

The species *Tanypus schineri* was recognised by Strobl (1880) from material collected and previously identified by Schiner (1862) as *Tanypus binotatus* (Wiedemann). The adult male is readily recognised by its distinctive abdominal pigmentation pattern and was included by Edwards (1929) and Goetghebuer (1936) in keys to the British and Palaearctic chironomid fauna as *Pentaneura schineri* and *Ablabesmyia schineri* respectively.

In the revision of European Tanypodinae Fittkau (1962) indicated that the adult male of this species was sufficiently distinct to warrent its assignment to a new genus within the Pentaneurini. However, he refrained from erecting a new genus at that time in the absence of juvenile material and referred to the taxon as Pentaneurini gen ? Schineri. In more recent years pupae and pupal exuviae of this species have been obtained in East Holstein and Southern Bavaria, Germany (leg. Reiss). Fittkau and Murray (1986) included a diagnosis for the pupal stage (as Tanypodinae Genus II) in the recently published keys and diagnoses to chironomid pupae of the Holarctic Region (Wiederholm, 1986).

The new genus *Schineriella* is now erected for this species and generic diagnoses are given for the adult male and pupa.

Schineriella gen. nov.

Type and only included species: *Schineriella schineri* (Strobl 1880) by present designation.

Generic diagnosis

Imago ♂:

Small to medium sized species, winglength 2.5–3.0 mm, terminal antennal flagellomere noticably narrower and distinctly set off from penultimate falgellomere. Scutal tubercle absent. Wings unmarked, R_{2+3} absent, costa not produced, anal lobe not developed. Anterior tarsus with beard, tibial spurs with main tooth and 3–4 side teeth. Tibial comb of 6–7 setae on hind leg. Volsella absent, transverse sternapodeme pointed anteriorly.

Pupa:

Thoracic horn somewhat swollen, "sausage" shaped; horn sac fills most of the lumen; plastron plate laterally displaced, circular and only 0.1× horn length. Shagreen spines narrow, sparse. Posterior border of tergite VIII projects backwards over anal lobe. Segment VII with only 3 LS setae, all in the distal 1/2. Anal macrosetae with adhesive sheaths.

Larva:

The larva is as yet unknown

Generic description

Imago ♂:

Small to medium sized species, wings 2.5–3.0 mm long. Body pigmentation cuticular; thorax brownish, vittae and median anepisternum somewhat darker; legs pale yellow; abdomen variously pigmented.

Head: Pale; eyes with dorsal, parallel-sided, extension, minimum width of eye bridge with 4 ocelli; temporal setae uniserial, inner verticals beginning level with apex of coronal triangle and merging imperceptably with outer verticals and post orbitals. Palps almost as long as the antennae and 1.5× as long as head width; palpomeres 3 and 4 equal in length and almost 2× as long as palpomere 2. Clypaeus long, narrow, slightly more than 2× as long as broad. Posterior tentorial pit close to tip of tentorium. Antenna with 14 flagellomeres; terminal flagellomere noticably narrower than penultimate flagellomere, 4–5× as long as broad and more or less cylindrical. AR about 2.0.

Thorax: Antepronotum reduced, scutal tubercle absent. Dorsocentral setae more or less uniserial between the vittae. Acrostichals biserial, almost reaching to the pre-scutellar field; scutellar setae biserial. Scutal tubercle absent, 3–4 flagelliform setae present in mid scutal region. Postnotum round posteriorly.

Wing: Membrane with macrotrichia, unpigmented. MCu beyond FCu, RM close to MCu, R_{2+3} absent, R_{4+5} close to R1 and costa. Costa not produced beyond end of R_{4+5} and ending clearly before tip of M_{1+2} midway between M_{1+2} and M_{3+4}. Anal lobe not developed.

Legs: Anterior tarsus with distinct beard, LR 0.91; tibial spur sinuous, with main tooth, reaching to 0.5× spur length, and 3–4 side teeth. Outer spur small on mid and hind legs, hardly reaching 0.5× inner spur length. Tibial comb, of 6–7 setae present on hind leg. Pulvilli absent, empodium approximately as long as the terminally spatulate claws.

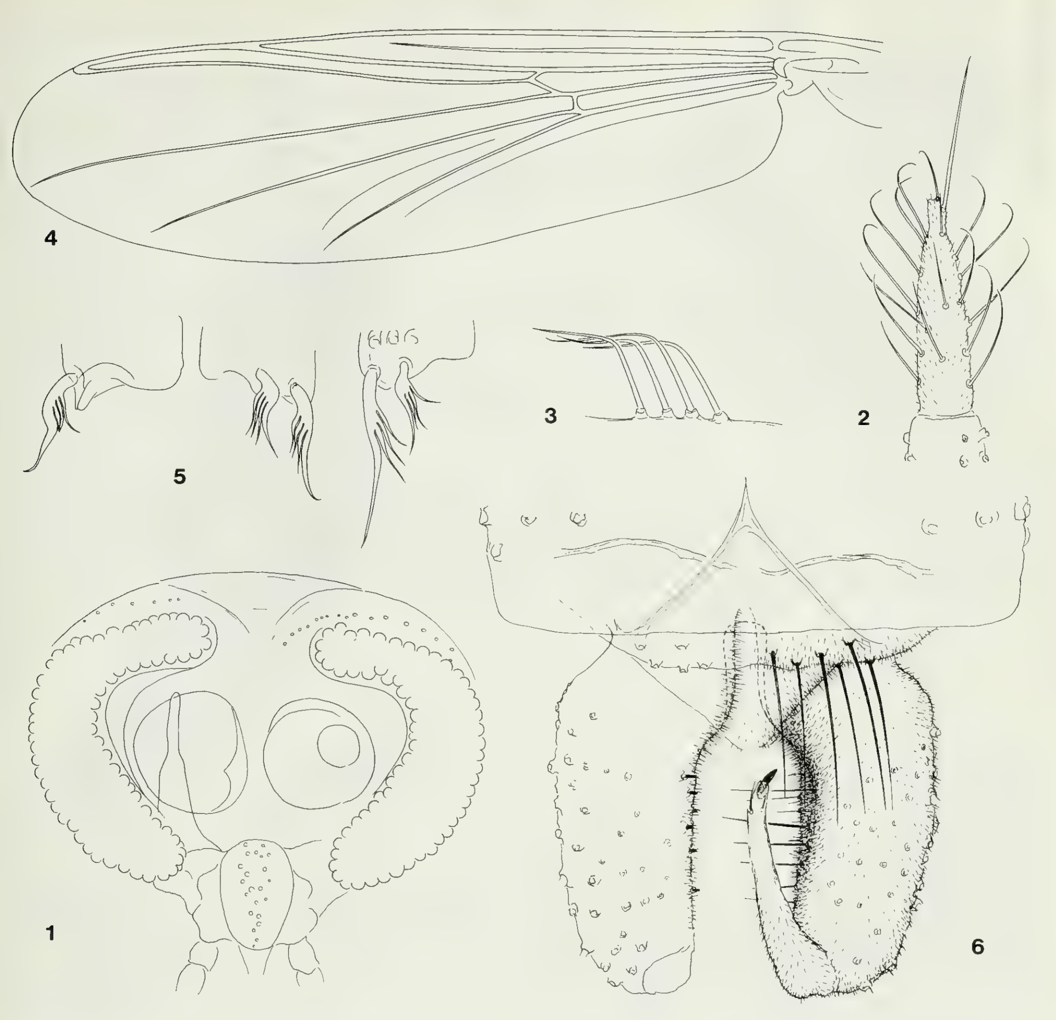
Hypopygium: Anal point large, triangular and broadly rounded apically. Gonocoxite more or less cylindrical, slightly swollen basally; dorsal and median surfaces setose on the distal 2/3, longest seta equal to, or slightly longer than, the gonocoxite width; entire surface with a more or less uniform covering of macrotrichia which are more dense in the anterior median field. Gonostylus slender, swollen basally and distally narrow, reaching 2/3–3/4 gonocoxite length. Terminal spur expanded medially, apically curved and pointed. Transverse sternapodeme distinctly pointed anteriorly.

Pupa:

Medium sized species, exuviae 6.0 mm in length and light, golden brown in colour.

Cephalothorax: Thoracic horn somewhat swollen, 3.0× as long as broad, slightly arched and more or less "sausage" shaped. External membrane with solitary spines. Horn sac fills most of the horn lumen, narrow basally, gradually expanded and connected to a small plastron plate by a narrow, sinuous, neck. Plastron plate slightly laterally displaced, set on a small tubercle, more or less circular in outline and only 0.1× horn length. Thoracic comb of 10–12 elongate, distally round or pointed, tubercles. Basal lobe distinct, conical and round apically. Thoracic membrane otherwise smooth. Thoracic setae filamentous and distally round, Dc_1 5.0× as long as Dc_2, Sa slightly longer than Dc_1.

Abdomen: Elongate, pigmented scar on tergite I. Shagreen spines narrow, solitary and relatively sparse. Posterior border of tergite VIII projects backwards over the anal lobe. Abdominal setation; D, V and L setae filamentous, distally round, D3 unusually long. Segment VII with only 3 LS setae,



Figs. 1.–6. *Schineriella schineri* gen. nov., comb. nov., adult male: 1. head; 2. terminal antennal flagellomere; 3. flagelliform setae on scutum; 4. wing; 5. tibial spurs; 6. hypopygium.

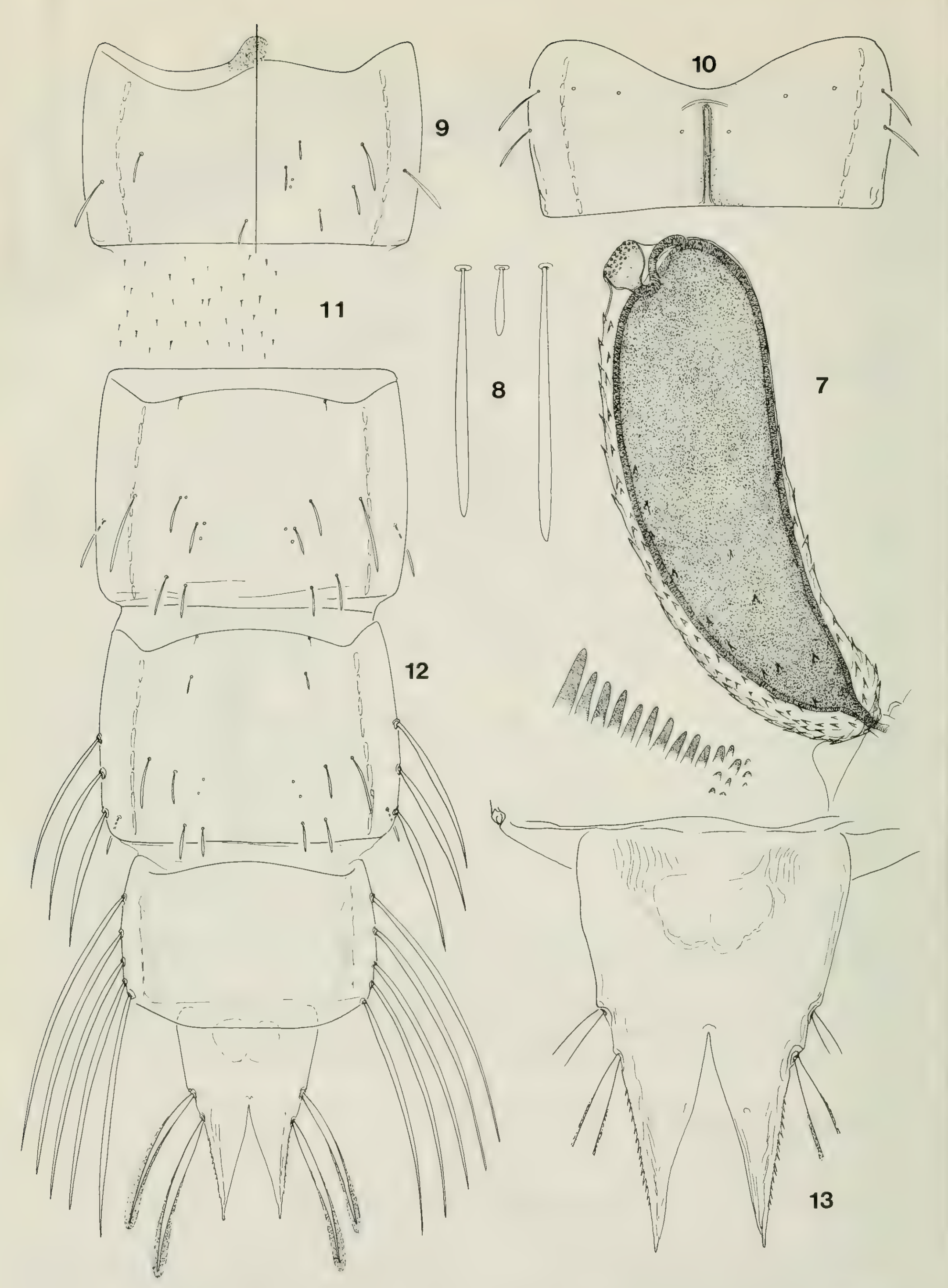
0.75× segment length, all in the distal 1/2. Segment VIII with 5 LS setae, 1.5× segment length. Anal lobe 1.5× as long as broad. Points evenly tapered. Outer border toothed in the distal 1/2, inner border smooth. Anal macrosetae, with adhesive sheaths, arising from the middle 1/3 of the outer border.

Larva:

The larva is so far unknown.

Schineriella schineri (Strobl) comb. nov.

Tanypus schineri Strobl 1880 p. 55
Pentaneura schineri Edwards 1929 p. 294
Ablabesmyia schineri Goetghebuer 1936 p. 45
Pentaneurini gen ? *schineri* Fittkau 1962 p. 275
Tanypodinae "Genus II" Fittkau & Murray, 1986 p. 64



Figs. 7.–13. *Schineriella schineri* gen. nov., comb. nov., pupa: 7. thoracic horn, basal lobe and thoracic comb; 8. thoracic setae; 9. tergite I; 10. segment IV; 11. shagreen; 12. segments VI–VIII and anal lobe; 13. anal lobe and female genital sacs.

Imago ♂ (Figs. 1–6)

Additional to generic diagnosis: Temporal setae 18, including inner and outer verticals and postorbitals. Clypaeus with 21 setae. Lateral antepronotal setae 4–5, humerals 3–4, dorsocentrals 20–22, acrostichals 36, prealars 7–8, supra alars 1. Abdominal tergites I–III and VI pale yellow, IV and V mostly dark brown with a pale posterior band, VII and VIII entirely dark brown. Tergite IX with a posterior transverse row of 12–15 backwardly directed setae.

Pupa:

See generic diagnosis and Figs. 7–13

Material studied: Imagines, 1 ♂, Murnauer Moos, Oberbayern, Germany 11/7/77; 1 ♂ same locality 21/6/78, both leg. Reiss; 1 ♂, Hart Saltacher See, Oberbayern, 16/6/80, leg. Plassmann; 1 ♂ Province of Adiyaman, Turkey, 21/6/85, leg. Schacht; 1 ♂ Witherslack, Westmorland, Great Britain, leg. Edwards, VI/1929; 1 ♂ Pe, Krebssee, Murnauer Moos, Oberbayern, 11/7/77, leg. Reiss; 1 ♀ Im and Pe (reared), Unter Ausgrabenssee, Plön, Holstein, Germany, 20/5/74 leg. Reiss.

Distribution and Ecology

Records of *S. schineri* exist from Austria (Strobl 1880), Belgium (Goetgehbuer 1936), Great Britain (Edwards 1929) and more recently from Holstein and Bavaria, Germany (leg. Reiss) and the Province of Adiyaman, Turkey (leg. Schacht). Although the larva has yet to be found it is likely to occur in sediments of small, nutrient rich ponds and small lakes containing much decaying leaf litter. Reiss (pers. comm.) has reared a pupa from such sediments taken from a depth of 1.5 m.

Systematic position of Schineriella

The new genus clearly belongs to the tribe Pentaneurini within the Tanypodinae. Fittkau (1962) tentatively indicated a relationship between Pentaneurini gen ?*schineri* and *Krenopelopia* on the basis of similarity in structure of the tibial spurs and male hypopygium. However, adult male imagines of the new genus are clearly separable from *Krenopelopia* by the presence in the latter of a well developed wing vein R_{2+3}, which clearly divides into its constituent veins R_2 and R_3. Moreover, the pupal stages of *Krenopelopia* and *Schineriella* are quite different, especially with regard to the thoracic horn which is trumpet shaped and with a well developed plastron in *Krenopelopia* in contrast to the bulbous horn and reduced plastron in *Schineriella* (see also Fittkau and Murray 1986 under Tanypodinae "Genus II").

Within the tribe Pentaneurini wing vein R_{2+3} is absent or reduced, together with *Schineriella*, in the genera *Labrundinia* Fittkau, *Monopelopia* Fittkau and *Nilotanypus* Fittkau. However, adults of the latter genera have either only a single tibial spur or no spur *(Labrundinia)* on the mid and hind legs in contrast to the two tibial spurs present on the mid and hind legs in *Schineriella*. The pupa of *Schineriella* most closely resembles *Labrundinia* in the form of the thoracic horn but may be readily separated by the backwardly projecting corners of tergite VIII and the presence of only 3 LS setae on tergite VII in *Schineriella*. The overall similarity is also apparent in the adult stage but apart from the tibial spurs further differences are evident in the terminal antennal flagellomere which is only weakly set off from the penultimate flagellomere in *Labrundinia* in contrast to the well differentiated and distinctly set off, narrower, terminal flagellomere in *Schineriella*. Additionally, the abdominal pigmentation is cuticular in *Schineriella* while *Labrundina* has subcuticular pigmentation.

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Bethbilbeckia floridensis: a new genus and species of Macropelopiini from the South Eastern Nearctic

(Diptera: Chironomidae)

By **E. J. Fittkau** and **D. A. Murray**

Abstract

The genus *Bethbilbeckia* is established for a species of Macropelopiini from the South Eastern United States. Generic diagnoses for the larva, pupa and adult male are given together with descriptions of all life stages of the single included new species *Bethbilbeckia floridensis* spec. nov.

Introduction

While reviewing some types and material of tanypodine species in connection with the ongoing cooperative work on keys and diagnoses to genera of the holarctic Chironomidae (Wiederholm 1983, 1986 et seq.) some Macropelopiini specimens were kindly donated by Elizabeth and Bill Beck, Jacksonville, Florida. The material in question had been reared from the larval stage and thus larval and pupal exuviae and adult male imagines were available for study. Such significant differences in morphology exist, in all life stages, that the specimens cannot readily be associated with any currently recognised genera. A description of the pupal exuviae of these specimens was given as Tanypodinae "Genus I" in Fittkau and Murray (1986). It gives us much pleasure to name the genus after Elizabeth and Bill Beck as a gesture of appreciation for their contribution to chironomid science. A complete generic diagnosis for the larva, pupa and male adult of *Bethbilbeckia* gen. nov. and descriptions of *Bethbilbeckia floridensis* spec. nov. are given in this paper.

The terminology and abbreviations used in the descriptions follow Saether (1980). The slide mounted holotype and one paratype is deposited in the collections of the Academy of Natural Sciences of Philadelphia; a second paratype is deposited in Zoologische Staatssammlung, Munich.

Bethbilbeckia gen. nov.

Type species. *Bethbilbeckia floridensis* spec. nov., by present designation.

Generic description

Imago ♂:

Medium sized species, winglength about 3.0 mm; Antennae with 14 flagellomeres, apical flagellomere indistinctly set off from preapical, A. R. about 2.9; eyes with dorsal extension; Temporal setae uniserial; antepronotum well developed, lobes well separated medially; scutal tubercle distinct; lateral antepronotal, anepisternal, preepisternal and postnotal setae present. Wings unmarked, membrane evenly covered with macrotrichia, MCu almost directly above FCu on M_{3+4}, costa strongly produced,

R_{2+3} present and forked, R2 distinct, anal lobe well developed; tibia I without comb, tibia III with comb of 4–5 setae; tibial spurs with main tooth and 9–13 side teeth; pulvilli absent. Tergite IX with strong setae posteriorly; gonocoxite more or less cylindrical, evenly setose and with pocket-like longitudinal depression anteriorly on inner border; volsellae absent; gonostylus abruptly bent through 90° near base and tapering towards apex.

Imago ♀: Unknown.

Pupa:

Medium sized, approximately 7.0 mm long, brownish in colour; thoracic horn tubular, expanding gradually from base to apex, 4.0× as long as maximum apical width; horn sac thinwalled, not quite filling the horn lumen, plastron plate oval, slightly longer than broad, 0.25× horn length; thoracic comb and basal lobe absent; thoracic setae simple, pointed or round apically; scar on tergite I elongate and pigmented; shagreen spines short, blunt and partially serially arranged in groups of 2–4; abdominal setae D_1 on segments II–VII large, distinct and arising from very large and prominent tubercles; D_2, D_3 on segments III–V arising from small tubercles; 4 short LS setae on segment VII, 0.25× segment length; segment VIII with 5 LS setae, 0.75× segment length; anal lobe longer than broad, with simple spine shagreen laterally, outer border fringed with long seta-like spinules and more or less convex, spinules reduced to indistinct decumbent spines at the distal end; inner borders divergent, without fringe but with 5–7 preapical decumbant spines; anal macrosetae arise from the basal 1/4.

Larva:

Antenna 5 segmented, 1.25× as long as mandible, basal segment 8× as long as basal width, ring organ at apical 1/3, AR about 9; ring organ at basal 1/3 of basal palp segment; mandible slender, curved, basal tooth distinct; ventrolateral setae 1 and 3 simple, 2 bifid; dorsomentum medially almost reaching the pseudoradula; ligula with 5 teeth; tooth row distinctly concave; inner teeth straight; paraligula bifid, pecten hypopharyngis with about 14 teeth; posterior parapods with normal and 3–4 wide claws.

Bethbilbeckia floridensis, spec. nov.

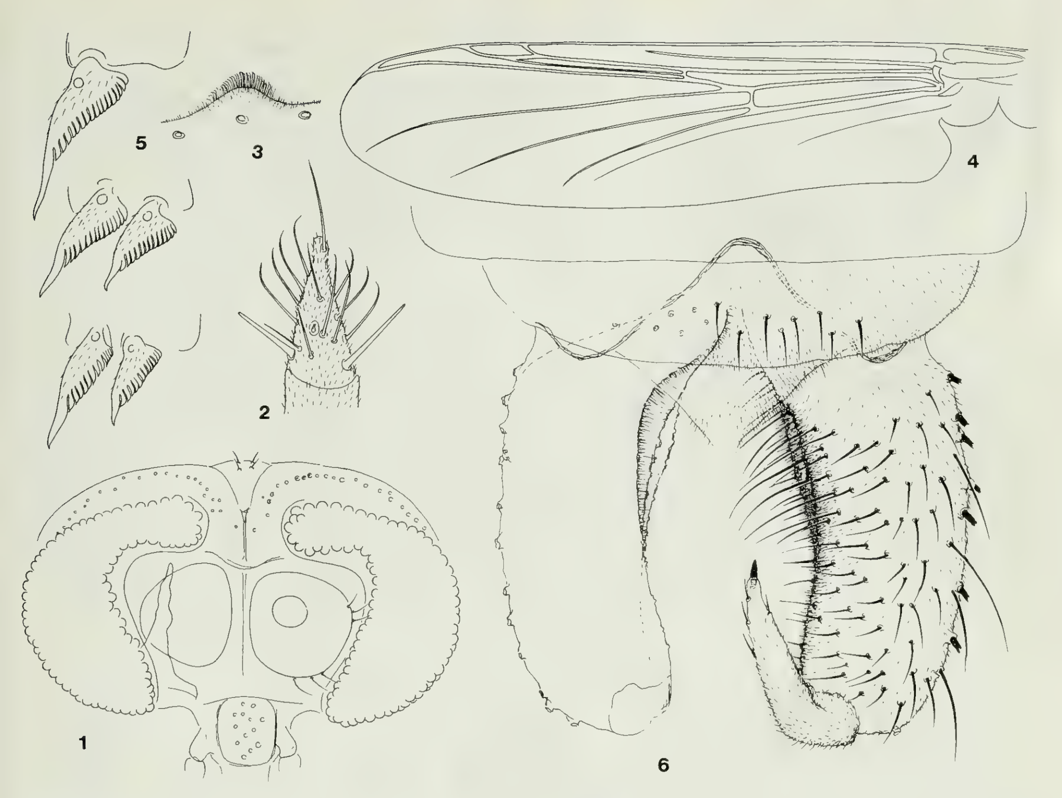
Imago ♂ (Figs. 1–6.)

Head: Pale brown, pedicel darker; eyes with dorsal extension. Frontal setae present, inner verticals 6–7, outer verticals 7–8, post orbitals 5–6. Antennal ratio 2.9; pedicel with three anteroventral and two lateroventral setae; flagellum with 14 flagellomeres, terminal flagellomere more or less conical, 1.5× as long as basal width.

Thorax: Brownish with vittae slightly darker; antepronotum well developed, lobes separated, with 9 lateral antepronotal setae; humerals XX; dorsocentrals irregularly biserial; supraalars 22, prealars 20–22; acrostichals biserial; preepisternals 4–6; anepisternals 2–4; scutellum with about 30 setae; postnotals 10 on either side; scutal tubercle distinct.

Table 1. Leg measurements (μ) and ratios for the holotype (a) and paratype (b) of *B. floridensis* spec. nov.

Leg	Fe	Ti	Ta 1	Ta 2	Ta 3	Ta 4	Ta 5	LR	BV
I a	947	1026	774	379	205	190	142	0.75	2.99
b	1010	1184	900	442	300	190	142	0.76	2.88
II a	916	1011	490	268	221	142	110	0.48	3.26
b	1105	1200	663	315	245	186	142	0.55	3.24
III a	868	1176	781	418	300	201	142	0.66	3.57
b	1026	1374	908	–	–	–	–	0.66	–



Figs. 1–6. *Bethbilbeckia floridensis* gen. nov., spec. nov., adult male: 1. head; 2. terminal antennal flagellomere; 3. scutal tubercle; 4. wing; 5. tibial spurs; 6. hypopygium.

Wing: About 3.0 mm long, with macrotrichiae; MCu on M_{3+4} close to FCu; RM removed from MCu by length of MCu; R_{2+3} present and forked, R_2 distinct; costa distinctly produced beyond R_{4+5}.

Legs: Pale, with faint indication of bands on apices of femora and bases of tibiae; spur Ti I with 13 side teeth, comb absent; spurs Ti II, Ti III with 9–10 side teeth; apex Ti III with comb of 4–5 setae; pulvilli absent; claws terminally pointed; leg ratios in Table 1.

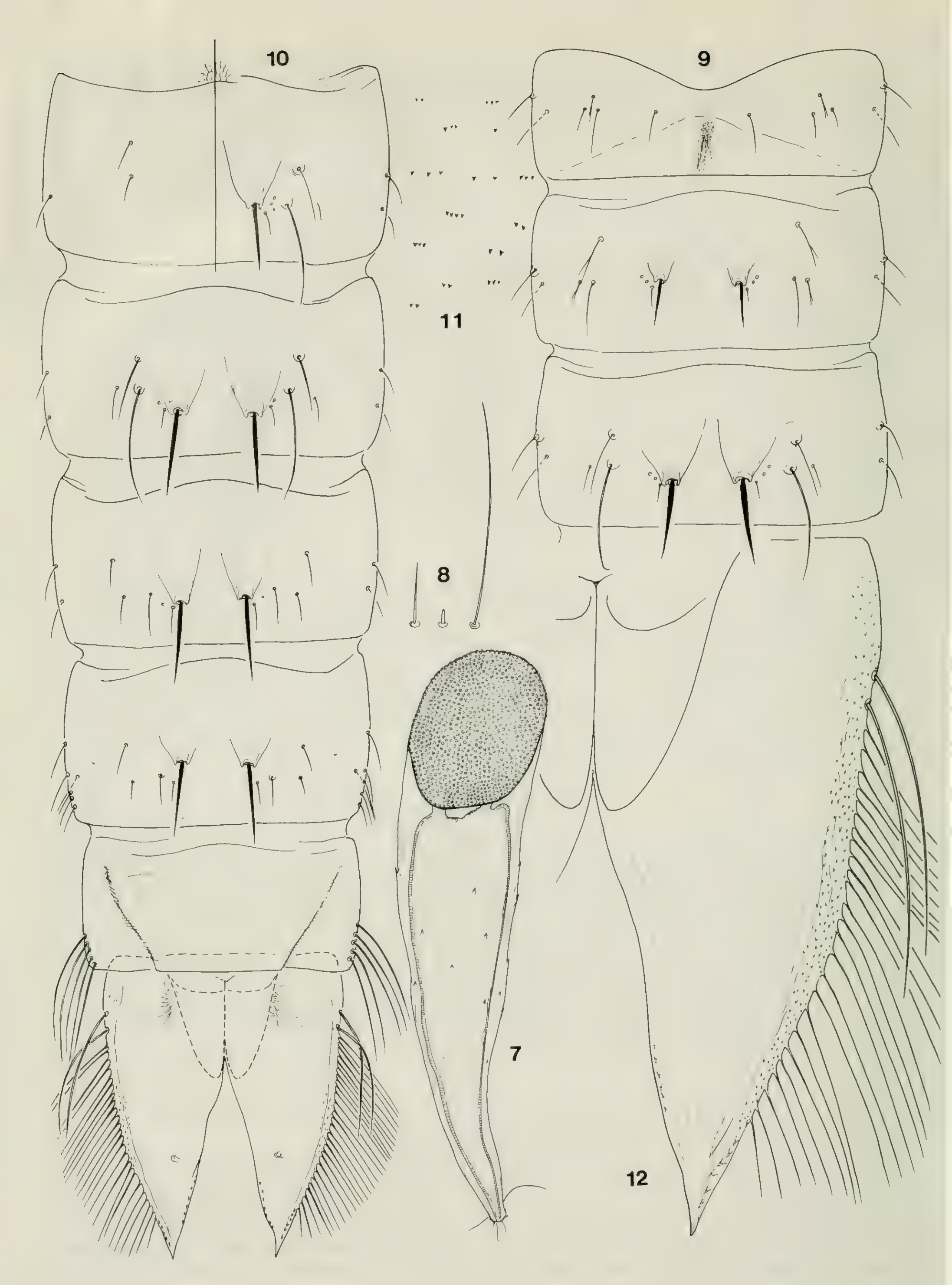
Abdomen: Uniformly brown, densly setose; ninth tergite with posterior multiserial row of 22–27 setae. Hypopygium (Fig. 6.) anal point triangular; gonocoxite more or less cylindrical, evenly setose and with pocket-like longitudinal depression anteriorly on inner borders; gonostylus setose, swollen basally and bent anteriorly through 90° near base.

Female. Unknown.

Pupa (Figs. 7–11.)

Medium sized, approximately 7.0 mm long, brownish in colour.

Thoracic horn tubular, relatively narrow, expanding gradually from base to apex, 4.0× as long as maximum apical width; external membrane smooth, with few spinules; horn sac thin-walled, not quite filling the horn lumen, evenly expanded towards the apex and connected to a more or less oval shaped plastron by two short necks; plastron plate slightly longer than broad, 0.25× horn length. Thoracic comb and basal lobe absent, thoracic membrane with transverse ridges extending to the median suture. Thoracic setae Dc_1 simple, pointed; Dc_2 extremely small, rounded, approximately 0.25 as long as Dc_1; Sa simple, long and pointed, 3.5× as long as Dc_1.

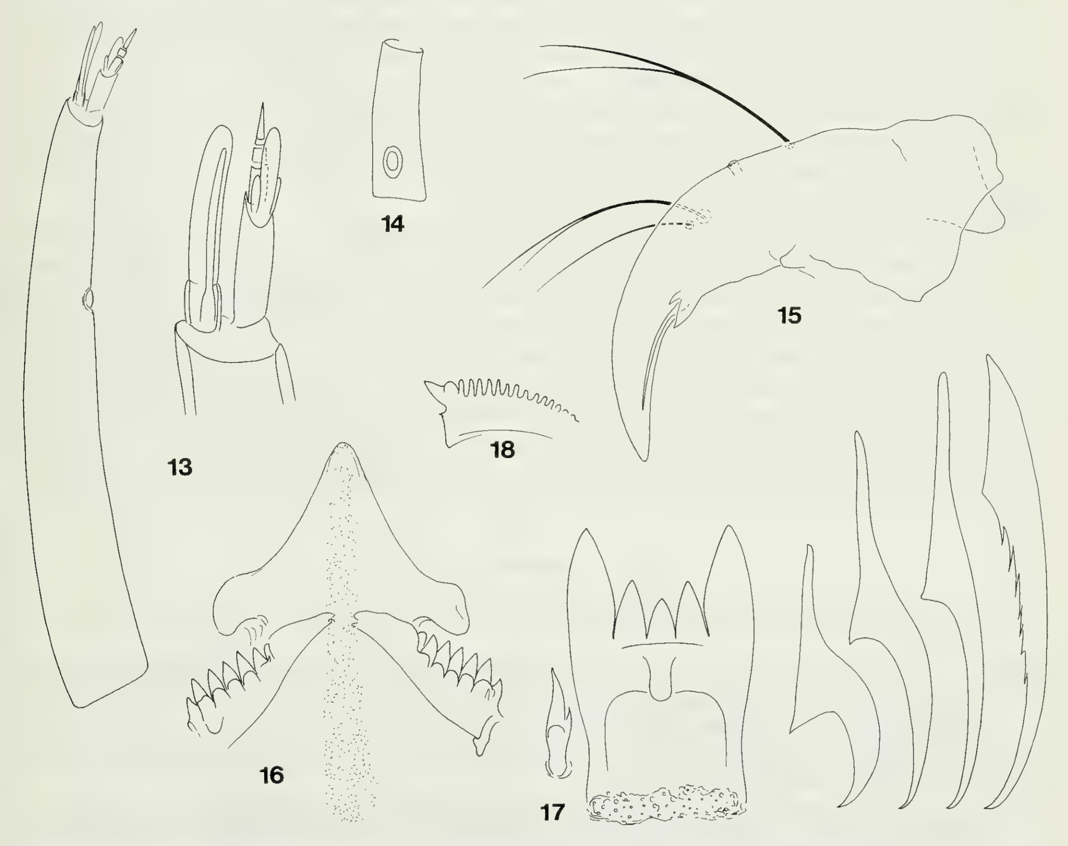


Figs. 7–12. *Bethbilbeckia floridensis* gen. nov., spec. nov., pupa: 7. thoracic horn; 8. thoracic setae; 9. tergites I–III; 10. segments IV–VIII and anal lobe; 11. shagreen; 12. anal lobe and ♂ genital sacs.

Abdomen: Scar on tergite I elongate and pigmented; shagreen spines short, blunt and partially serially arranged in groups of 2–4. Abdominal setae D_1 on segments II–VII large, distinct and arising from very large and prominent tubercles; remaining D and V setae of varying sizes, D_2, D_3 on segments III–V arising from small tubercles; segments I–VII with 2 L setae; 4 short LS setae on segment VII, 0.25× segment length; segment VIII with 5 LS setae, 0.75× segment length. Anal lobe longer than broad, with simple spine shagreen laterally, outer border fringed with long seta-like spinules and more or less convex, spinules reduced to indistinct decumbent spines at the distal end; inner borders divergent, without fringe but with 5–7 pre-apical decumbant spines. Anal macrosetae 0.5× segment length, arise from the basal 1/4.

Larva. (Figs. 13–18.)

Head capsule yellowish; antenna 5 segmented, 1.25× as long as mandible, basal segment 8× as long as basal width, ring organ at apical 1/3, AR about 9; basal segment of maxillary palp about 3× as long as wide, ring organ at basal 1/3. Mandible slender, curved, basal tooth distinct with apically directed crest extending over inner margin and smaller inner tooth; ventrolateral setae 1 and 3 simple, 2 bifid. Dorsomentum on each side with 5–6 side teeth, inner part extending medially and almost reaching the pseudoradula. Ligula about 1/3 longer than apical width, with 5 teeth; tooth row distinctly concave, outer tooth 2.5× middle tooth; inner teeth straight. Paraligula bifid, 0.5× as long as ligula. Pecten hypopharyngis with 14 teeth, inner tooth large, medially directed and with a low rounded protuberance on outer border. Posterior parapods with normal and 3–4 wide claws.



Figs. 13.–18. *Bethbilbeckia floridensis* gen. nov., spec. nov., larva: 13. antenna; 14. maxillary palp; 15. mandible; 16. mentum; 17. ligula and paraligula; 18. pecten hypopharyngis; 19. Claws of posterior parapod.

Material studied: Holotype; Larval and pupal exuviae and adult male (reared) slide mounted in Euparal in the collections of the Academy of Natural Sciences of Philadelphia (ANSP). Coll. E. & W. Beck, Peter's Creek, Clay County, Florida 6.7.68.

Paratypes: 1 associated larva-pupal-adult male, slide mounted, in coll. ANSP; 1 associated larva-pupa-adult male, slide mounted in coll. Zoologische Staatssammlung, Munich, West Germany. Both paratypes were collected at the same site as the holotype.

Systematic position

The new genus clearly belongs to the tribe Macropelopiini which was recently enlarged to include the genus *Radotanypus* (Fittkau and Murray 1985) and is now considered to be composed of the genera *Psectrotanypus* Kieffer, *Derotanypus* Roback, *Alotanypus* Roback, *Brundiniella* Roback, *Macropelopia* Thienemann, *Radotanypus* Fittkau and Murray, *Apsectrotanypus* Fittkau, *Fittkauimyia* Karunakaran and *Bethbilbeckia*. The larva of *Derotanypus* and *Psectrotanypus* differ from those of all other genera in the tribe by having only 4 teeth in the ligula in contrast to the more usual arrangement of 5. It is thus not necessary to consider these two genera further in the present context. In Fittkau and Roback (1983) the larva keys easily to couplet 12 which leads to the genera *Alotanypus, Brundiniella, Apsectrotanypus* and *Macropelopia. Alotanypus* differs from these and the recently described larva of *Radotanypus* (Epler 1986) in having all ventrolateral mandibular setae simple while in the remaining above mentioned genera ventrolateral setae 1 and 3 are multibranched. In *Bethbilbeckia* setae 1 and 3 are simple and seta 2 is clearly bifid only. The pupa of *Bethbilbeckia* is readily separable from all other members of the Macropelopiini. Although superficially similar to *Macropelopia* it is easily distinguished by the prominent, straight D_1 setae which arise from distinct tubercles- larger than those present in other Macropelopiini. The very short, weak, LS setae on segment VII are also diagnostic for the genus. In the key to genera of holarctic tanypodine pupae *Bethbilbeckia* has been included as "Tanypodinae Genus I" (Fittkau and Murray 1986 p. 64, Fig. 5.46).

In Roback (1972) the adult male keys to couplet 9 which includes *Macropelopia decedens* (Walk.) and *Parapelopia serta* Roback. The former is "a large northern species" in the U.S.A. while the latter is a "small Florida species" (Roback op. cit p. 87). Roback (1982) has already drawn attention to the possible synonomy between *Parapelopia* Roback and *Fittkauimyia* Karunakaran. The adult male of *Bethbilbeckia* differs from all other Macropelopiini, with the exception of *Fittkauimyia* in the uniserial arrangement of the temporal (inner and outer vertical and postorbital) setae. However *Bethbilbeckia* may be easily separated from *Fittkauimyia* in having preepisternal setae and a posterior multiserial row of setae on tergite IX of the abdomen. An additional differential character is seen in the tibial spurs where *Bethbilbeckia* has a maximum of 13 side teeth compared with 13–20 in *Fittkauimyia.*

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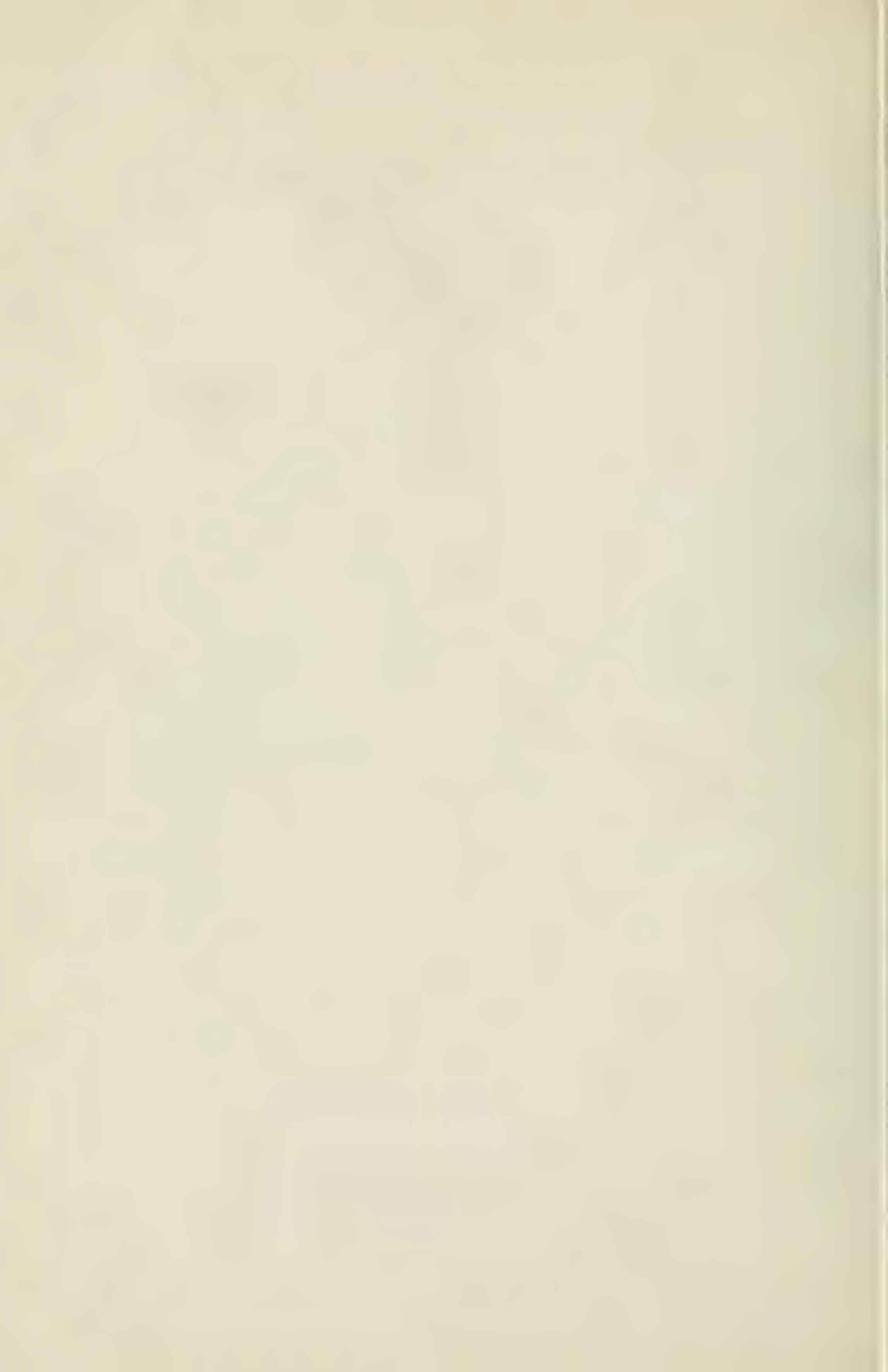
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Wanderungen der Schwebfliegen (Diptera, Syrphidae) am Randecker Maar

Wulf Gatter und Ulrich Schmid

Herausgegeben
von
E. J. Fittkau

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Aus der Station Randecker Maar/Schwäbische Alb
Vogelzug – Insektenwanderungen

Die Wanderungen der Schwebfliegen (Diptera, Syrphidae) am Randecker Maar

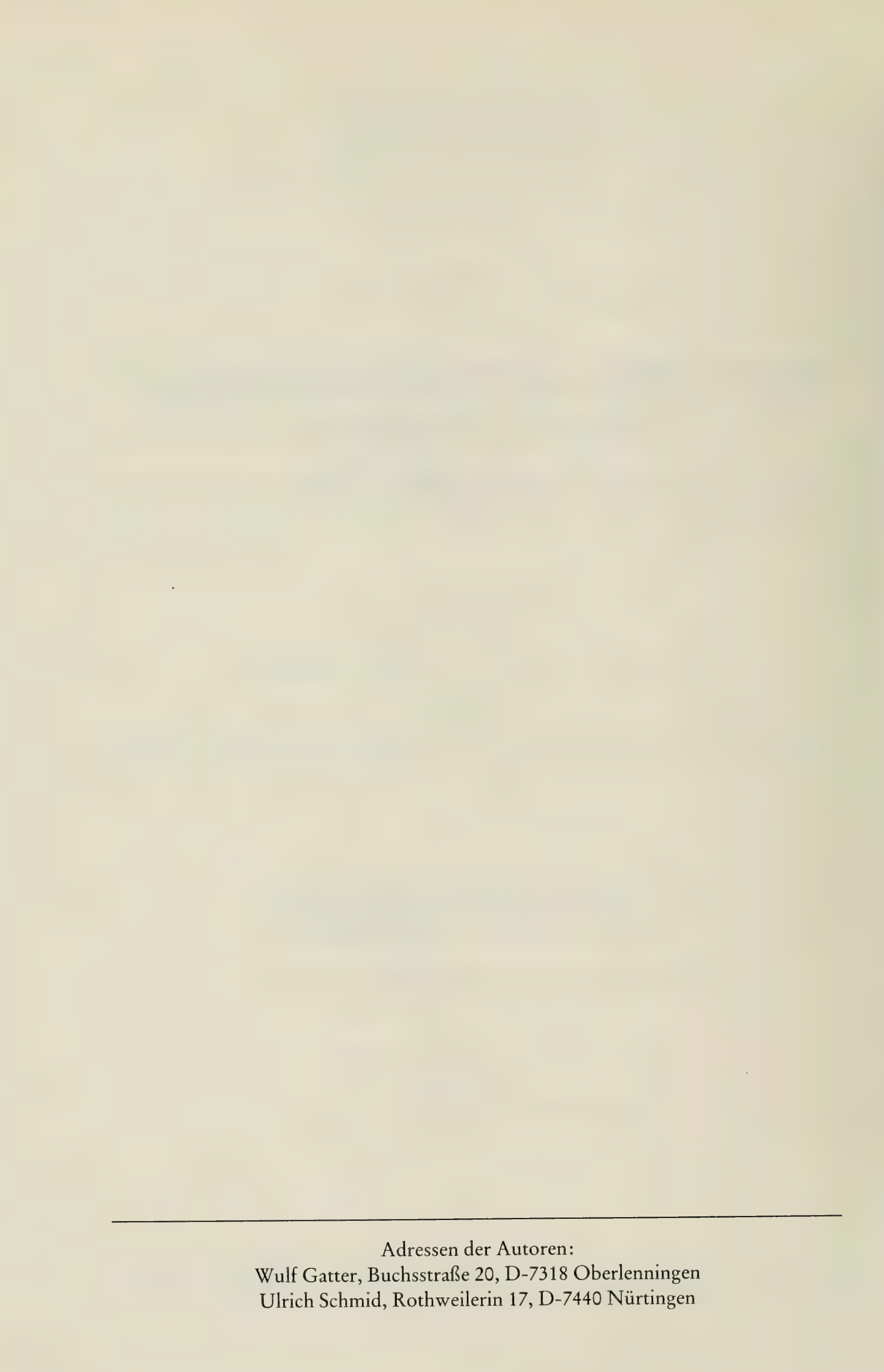
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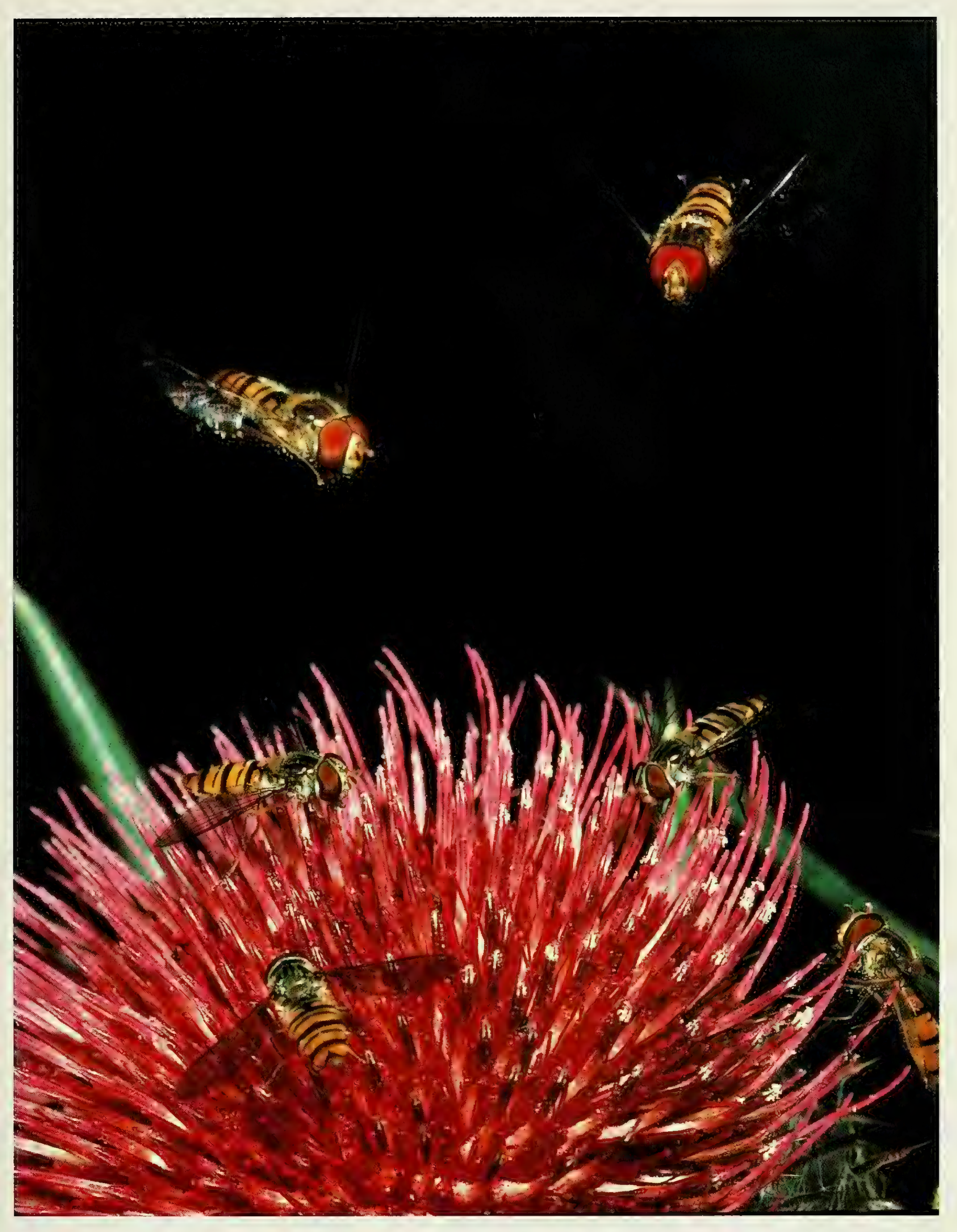
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Die Schwebfliege *Episyrphus balteatus*. Zwei ♂♂ fliegend; auf der Blüte nach oben zwei ♀♀ (Ph. E. Kotzke).



Zum zwanzigjährigen Bestehen der Station Randecker Maar

Während es in der Zoologie bis heute die verschiedensten Modeströmungen gab, denen teils jahrzehntelang das bevorzugte Augenmerk der Forschung galt, hat die Migrationsforschung zu keiner Zeit etwas von ihrer Faszination verloren und ist heute so aktuell wie früher.

Im Gegensatz zur Vogelzugforschung fanden aber die Insektenwanderungen erst spät das Interesse der Fachwelt und das erste Fachbuch zu diesem Thema wurde 1930 publiziert. Dabei waren es vielfach die Vogelzugforscher, die uns frühe Hinweise auf Insektenmigrationen übermittelten. Heinrich Gätke verdanken wir Berichte aus dem vorigen Jahrhundert über Massenwanderungen von Schmetterlingen nach Helgoland. Schon 1872 erkannte er die Zusammenhänge von abnormen Wetterlagen und dem Auftreten südlicher Vögel und Schmetterlinge auf der Insel: „Lepidoptera (-migrations) . . . are subjects to the same meteorogical influences as birds . . ." Neben Verdichtungen des Zuges entlang der Küsten haben Kanalisierungseffekte an Gebirgspässen in allen Teilen der Welt bei der Erfassung des Vogelzugs wie auch der Insektenmigrationsforschung eine große Bedeutung.

C. W. Mackworth-Praed, der berühmte Afrika-Ornithologe, wies als einer der ersten auf Massenwanderungen von Schwebfliegen über den Kanal hin. Das britische Forscherehepaar D. & E. Lack entdeckte bei Vogelzugbeobachtungen in den Pyrenäen auffälligen Insektenzug und machte die Wissenschaft auf die dortigen Pässe aufmerksam.

Auch die Bedeutung des Bretolet-Passes in der Westschweiz, langjähriges entomologisches Arbeitsgebiet für J. Auberts Migrationsforschungen an Insekten, war bei ornithologischen Untersuchungen erkannt worden.

Schon Anfang der sechziger Jahre faszinierten uns die Admirale, die jeden Herbst mit der Zugrichtung der Vögel über die Schwäbische Alb nach Südwesten zogen. Als die Station Randecker Maar nach ersten Versuchen von 1967 bis 1969 im Jahre 1970 einen regelmäßigen Stationsbetrieb aufnahm, lagen die Arbeitsschwerpunkte „VOGELZUG – INSEKTENWANDERUNGEN" fest. Seitdem sind zahlreiche Veröffentlichungen zu beiden Themen erschienen. Mit dem vorliegenden Schwebfliegenheft findet ein erstes Projekt der Station seinen Abschluß. Monographien über den Zug der Schmetterlinge und der Vögel werden folgen.

Ursprünglich war die Stationsarbeit auf wenige Jahre konzipiert. Doch die zahlreichen Fragen, die nach zwei Jahrzehnten blieben, zeigen immer mehr, daß manche Aspekte nur in Langzeitprojekten zu klären sind. Neben vielen ungelösten Problemen ist die Spannbreite der Erscheinungsformen im Migrationsbereich selbst nach 20 Jahren offenbar nicht annähernd erfaßt, wie uns die alljährlichen Überraschungen zeigen.

Dies dürfte einer der Gründe sein, weshalb sich manche der inzwischen über 350 jungen Mitarbeiter (Biologen, Schüler und Studenten) über Jahre hinweg, von erstaunlichem Enthusiasmus getragen, ehrenamtlich an der oft harten Stationsarbeit beteiligen. Regen, Schnee und Wind ausgesetzt, wurden die Beobachtungen in den ersten Jahren bis in den Dezember hinein ausgedehnt. Ein Schäferkarren diente gleichermaßen als Küche und Büro wie auch als spartanische Schlafstatt und hatte wenig gemein mit der bescheidenen Gemütlichkeit der heutigen Stationsunterkunft.

Mit den 70000 bisher geleisteten Beobachtungsstunden kann inzwischen ein unersetzliches Material von Millionen Daten zur Langzeitdynamik von etwa 100 Vogelarten und zahlreichen Insektenarten, und damit Basismaterial für die Naturschutzarbeit geliefert werden.

Die Station hat ihre Tätigkeit während der ersten Jahre ohne jegliche finanzielle Unterstützung betrieben.

Meinen Freunden von der Ortsgruppe Kirchheim/Teck und dem Landesverband Baden-Württemberg des Deutschen Bundes für Vogelschutz (DBV) ist es zu verdanken, daß schließlich durch jährliche Zuschüsse ein finanzieller Grundstock geschaffen wurde. Doch letztendlich wäre der Betrieb der Station ohne die vielen privaten Spender und Helfer nicht möglich gewesen, denen ein besonderes Kapitel auf Seite 95 gewidmet ist. Ganz besonders möchte ich mich bei meinen Freunden Prof. Dr. H. Mattes und K. Sill bedanken, die zeitweise die organisatorischen Geschäfte der Station führten. Ihnen und allen anderen, die unsere Arbeit unterstützten, herzlichen Dank.

Last not least, der herzlichste Dank an meine Frau Dorothea. Sie hat die Station nicht nur von Anbeginn durch alle Schwierigkeiten mitbegleitet, sondern hat sich neben ihrer Mitarbeit als Entomologin besonders um die Betreuung der Mitarbeiter bemüht und beim Organisatorischen mitgewirkt.

Lenningen, November 1989 — Wulf Gatter

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Die Wanderungen der Schwebfliegen (Diptera, Syrphidae) am Randecker Maar

Von **Wulf Gatter** und **Ulrich Schmid**

Abstract

Hoverfly migration (Diptera, Syrphidae) at Randecker Maar, SW-Germany

During the years 1975–1987 (except 1983) hoverfly migration was investigated at the migration research station "Randecker Maar – Schwäbische Alb" (SW-Germany; 48.35 N, 9.31 E, 772 m). From mid July or the end of July to the beginning of October of these 12 years, 90049 syrphids migrating southward were collected with a large net trap which opened to the north (S-trap). During 5 years, 9815 hoverflies migrating northward were caught with a similar trap which opened to the south (N-trap) (see Tab. 1).

Aspects of the phenology of species with more than 50 individuals collected (see Tab. 2) are described in the present paper (3.1, 3.2), e. g. the seasonal and diurnal activity patterns of the species and sexes, differences between the two traps, sex-ratios, captures in relation to wind directions. Earlier observations of migrations of the species are summarized, and each species is arranged (if possible) in one of the following categories:

I) Anemomigration (drift): passive transport of flight-inclined insects by wind without direction orientation.

II) Dismigration: endogenously (dispersal) and exogenously (spacing) released active dismigrations without or with only indirect direction orientation (selection of favourable winds).

III) Migration: migration of individuals or species programmed to endogenous migration and direction orientation.

Both dismigration and migration can be expansive (without returning) or seasonal (migration to and return from summer, winter or diapause habitats).

Tab. 3 shows all known migratory species of Europe.

The phenology of seasonal migrants (species which migrate orientated into winter and summer areas; see Tab. 3) is characterized as follows:

1. The difference between numbers in traps and supplementary field observations show that the flies move in late summer and autumn in southerly and southwesterly directions.
2. Field observations indicate that seasonal migrants move northward in spring.
3. There are characteristic differences in the phenology of seasonal migrants between the Randecker Maar and the Col de Bretolet (Swiss Alps, 1923 m) which is situated 350 km to the southwest: in most cases maximum southbound migration peaks are later at Col de Bretolet. Migratory birds show the same shift of the maxima. During their S and SW orientated migration, both birds and hoverflies cross Randecker Maar some days before they reach the more southwesterly situated Col de Bretolet (4.1).
4. At Randecker Maar and more northerly sites, males and females of most seasonal migrants appear in nearly equal numbers. At Col de Bretolet, females predominate clearly (see Tab. 5). – Females of *Episyrphus balteatus* have a much longer lifespan than males. At the beginning of the migration period, males participate in great numbers; during migration an increasing proportion of them dies. At the end of the migration period, only females are left. The later peak at Col de Bretolet causes predominance of females at this site (4.2).
5. Only if there is a headwind do seasonal migrants fly close to the ground in order to diminish the unfavourable influence of this wind. They make use of the helping influence of a tailwind by flying at a greater height. Therefore southbound migrants are caught in the trap in much greater numbers when the wind blows from the south (3.4).
6. Seasonal and diurnal migration patterns are very similar from year to year apart from the high fluctuation of numbers.

The group of dismigrating species (see Tab. 3), which have an active dispersal migration, can be less clearly characterized. The following features of the phenology of these dismigrants are not shared by all species – a consequence of the differing functions, extents and ranges involved:

1. The difference between numbers of flies collected in the two traps is often low; no preferred direction of flight is distinguishable. – In some species the difference is higher; presumably they choose favourable wind directions for migration.

2. In most cases there is no difference between the seasonal activity patterns of Randecker Maar and Col de Bretolet (4.1).

3. The differences of sex ratios at Randecker Maar and Col de Bretolet which are shown by seasonal migrants are not present in seasonal dismigrants (see above; Tab. 5; 4.2).

4. In all species, females predominate at Randecker Maar. Flight activity of females close to the ground level is probably greater than that of males due to the females' search for favourable egg laying habitats.

5. Seasonal dismigrants do not react to different wind directions in the same manner as seasonal migrants (see above). Migrations with tailwind take place (at least in part) close to the ground (3.4).

For some ecological groups of the family Syrphidae, seasonal migrations are an integral part of their life cycles (4.3, 4.4):

1. Seasonal migration is known only from species with zoophagous (aphidophagous) larvae or from species with aquatic sapro-/microphagous larvae.

2. In particular species with hibernating imagines or puparia are seasonal migrants (see Tab. 3). These species cannot survive the winter in northern parts of their summer range, or they survive only in small numbers under optimal conditions. So they immigrate into these areas in spring. In summer and autumn they move back to the south. – Some species with hibernating larvae migrate in the same manner. Presumably migration to southern Europe can also reduce winter mortality of their larvae.

3. The adaptive advantage of migration to the south in summer and autumn is an increase of their chance of surviving the winter. The advantages of spring migration to the north for aphidophagous species are the much better conditions for larval development (maximum of aphids) and imaginal feeding (richness in "fly-flowers") in central and northern Europe; for aquatic species the presence of larval habitats in much higher densities and with much lesser risk of drying up than in the summer-arid southern Europe.

The most important function of dismigration is to find habitats with favourable conditions for larval development. Also in such migrations species with zoophagous larvae are the most common participants (4.3); they depend on food resources which occur unpredictably in time and space (species see Tab. 3).

Aphidophagous hoverflies show different life cycles, which are partly correlated with spring and/or autumn maximum of aphid density (mono- and bivoltine species). Polyvoltine species have to integrate migration periods in their life cycles to enhance the chances for successful reproduction during aphid minimum in summer. They are much less specialized in habitat selection and larval diet than mono- and bivoltine species. In polyvoltine zoophagous syrphids two groups compete for larval food: seasonal migrants and seasonal dismigrants (see Tab. 3). The former are better direct competitors for food, the latter are able to use a higher variety of food (4.3).

Species with terrestrial saprophagous or phytophagous larvae are not forced to migrate to find their often predictably occuring larval food resources. Some saprophagous hoverflies dismigrate over short distances (see Tab. 3). No migratory species is known among the usually highly specialized phytophagous species (4.3).

The migration behaviour of Syrphidae shows much similarity to that of other well-known migratory insects, e.g. the butterflies (Lepidoptera) (4.5). There are strong connections between diapause and migration (species with diapausing imagines migrate; 4.5.2), number of generations per year and migration (in particular polyvoltine species migrate; 4.5.3) and between the dimension of the distribution area and migration (migrants have vast areas; 4.5.1).

Some of our common hoverfly species are the most impressive migrants amongst European insects in respect of dimensions and regularity of their migrations.

Furthermore most of the hoverfly species which are important as aphid predators in agriculture and forestry are migrants. If some of these species offer the possibility to act as biological pest control a precise knowledge of the life cycle of each species is necessary. The influence of migratory behaviour has been greatly underestimated up to now in the research on biological pest control.

1. Einleitung: Überblick über die bisherige Erforschung von Schwebfliegenwanderungen

Wandernde Schwebfliegen haben gelegentlich schon früher Aufmerksamkeit erregt, wenn sie in gewaltigen Massen auftraten (z. B. Eimer 1880, Prell 1925, Walker 1864) oder extrem weit außerhalb ihrer Verbreitungsgebiete gefunden wurden (z. B. *Syrphus ribesii* auf Spitzbergen; Elton 1925).

Auf die Möglichkeit regelmäßiger Schwebfliegenwanderungen wiesen aber erst D. & E. Lack (1951) nach Beobachtungen von gegen den Wind nach WSW fliegenden *Episyrphus balteatus* an einem Pyrenäenpaß hin. Williams et al. (1958) bestätigten und vertieften diese ersten Kenntnisse über regelmäßige Syrphidenzüge.

Nachdem diese Beobachtungen auf völlig neue Aspekte der Ökologie von Dipteren hinwiesen, brachten die folgenden Jahre so wenig neue Erkenntnisse, daß zwei in den 1960er Jahren erschienene Standardwerke über Insektenwanderungen (Williams 1961, Johnson 1969) kaum mehr als eine Seite benötigten, um das Wissen über Syrphidenmigration zusammenzufassen.

Erst die Forschungen von Aubert und seiner Arbeitsgruppe brachten wesentliche Fortschritte (Aubert 1962, 1964a, 1964b, 1964c, 1969; Aubert, Aubert & Goeldlin 1976; Aubert & Goeldlin 1981; Aubert, Goeldlin & Lyon 1969; Aubert & Jaccard 1981; Dethier & Goeldlin 1981, Goeldlin 1975). In den Jahren 1962–1973 betrieb die Arbeitsgruppe jeweils ab Ende Juni oder Anfang Juli bis zu den ersten stärkeren herbstlichen Schneefällen Insektenreusen am Col de Bretolet, einem in 1923 m Höhe gelegenen Paß in den wallisischen Alpen. Der Col de Bretolet liegt am Schluß des vom Rhônetal in südwestlicher Richtung heraufziehenden Val d'Illiez. Die Ergebnisse dieser zwölfjährigen Beobachtungen sind in Form von Tagessummendiagrammen und einer sehr knapp kommentierten Artenliste bei Aubert et al. (1976) dokumentiert.



Der paßähnliche Einschnitt im Norden des Randecker Maars.



Die Reuse am Randecker Maar.

Neben diesen Routinefängen wurden an verschiedenen Alpenpässen Massenfangaktionen mit sehr großen Netzreusen durchgeführt. Durch Wiederfänge von dabei markierten Schwebfliegen sind Wanderungen einzelner Individuen über maximal 111 km belegt! Über die von NE nach SW hintereinander liegenden Pässe Krinnenpaß (1659 m), Col de la Croix (1778 m), Col de Cou und Col de Bretolet (1921 und 1923 m), Col de la Golèze (1671 m) und Col du Glandon (1961 m) konnten Schwebfliegenwanderungen über ca. 160 km verfolgt werden. Im Verlauf dieser Wanderung wird zwischen dem Col de la Croix und dem Col de Bretolet auch das Rhônetal (430 m) gequert.

Nach der Markierung am Col de Bretolet hatten die ersten Fliegen den 3,6 km entfernten Paß La Golèze schon in 10–15 Minuten erreicht. Die unter sehr ungünstigen Witterungsbedingungen am Col du Glandon in 111 km Entfernung wiedergefangenen Tiere waren vermutlich drei Tage vorher markiert worden (Aubert et al. 1969).

An verschiedenen Stellen der Schweiz und Österreichs ergaben kurzfristigere Versuche (z. B. Aubert & Jaccard 1981, Dethier & Goeldlin 1981, Gepp 1975) ähnliche Beobachtungen, so daß die Phänologie der herbstlichen Schwebfliegenwanderungen im Alpenraum als gut bekannt betrachtet werden kann.

Aus anderen Gebieten fehlen längerfristige Beobachtungen allerdings fast völlig.

Nachdem an der Station Randecker Maar seit Anfang der 1960er Jahre immer wieder auffälliger Schwebfliegenzug beobachtet worden war (z. B. Gatter & Gatter 1973, Gatter 1975a), begann man dort daraufhin mit der systematischen Untersuchung der Wanderungen mit Hilfe von Insektenreusen. Erste Ergebnisse aus dem Jahr 1975 liegen bereits publiziert vor (Gatter 1976); sie lassen hinsichtlich der Artenzusammensetzung große Übereinstimmungen zwischen den Beobachtungen in den Alpen und denen im südwestdeutschen Mittelgebirgsraum erkennen. In einer Analyse dieses Artenspektrums wurden charakteristische Merkmale einer von Wanderarten geprägten Schwebfliegenfauna deutlich (Schmid & Gatter 1988).

Erste systematische Beobachtungen zum Auftreten von Schwebfliegen auf einer Nordseeinsel ohne bodenständige Syrphidenfauna (Schmid 1987) deuten darauf hin, daß auch im norddeutschen Tiefland regelmäßige spätsommerliche Syrphidenwanderungen stattfinden, an denen dieselben Arten wie im Hoch- und Mittelgebirgsraum teilhaben.

Die am Randecker Maar gewonnenen und hier dargestellten Daten zum Wanderverhalten der Schwebfliegen dürften also grundsätzliche Gültigkeit wenigstens für den mitteleuropäischen Raum haben.

2. Material und Methode

2.1 Lage der Station Randecker Maar

Die Forschungsstation liegt im Südwesten der Bundesrepublik Deutschland (Abb. 1) am Nordrand der Schwäbischen Alb, einem sich von SW nach NE erstreckenden Mittelgebirge, das steil über seinem nördlichen Vorland aufragt. Im Bereich der Station liegt das Vorland in ungefähr 400 m NN, der Albtrauf in ca. 800 m NN (Abb. 2a, 2b). Der nahezu runde Kessel des Randecker Maars ist nach Norden geöffnet und unterbricht den Albtrauf mit einer tiefen Kerbe. Diesen Einschnitt nutzen in breiter Front aus Nordost heranziehende Vögel und Insekten, um hier mit geringerem Energieaufwand die Höhe der Albhochfläche zu gewinnen. Dadurch kommt es am Randecker Maar zu starken horizontalen und vertikalen Verdichtungen des Zuggeschehens (Gatter 1978, 1981a).

Die Beobachtungsstation selbst (48.35 N, 9.31 E) befindet sich südlich des Maars am Rand einer kleinen Kuppe in 772 m über NN (Abb. 2a). Sie bietet freie Sicht nach allen Himmelsrichtungen außer nach SE, wo die Kuppe von Gebüschgruppen mit einigen niedrigeren Bäumen bewachsen ist.



Abb. 1: Die Lage der Station „Randecker Maar“ in Südwest-Deutschland.
Fig. 1: Position of the Migration Research Station “Randecker Maar” in SW-Germany.

2.2 Fang der Schwebfliegen

Die wandernden Schwebfliegen werden mit Hilfe einer trichterförmigen, nach NNE geöffneten Insektenreuse gefangen. Die Reusenöffnung hatte in den Jahren 1975–1977 eine effektive Größe von 5 m^2 (2,5 m Höhe = 2 m Höhe über der Wiesenvegetation; 2,5 m Breite), in den Jahren 1978–1982 und 1984–1987 eine effektive Größe von 10 m^2 (5 m Breite). Die Wände und das zum Fangbeutel hin leicht ansteigende Dach bestehen aus Fliegengitter. Den nach SSW gerichteten inneren Abschluß bildet ein 20 cm breites, mit Plastikfolie bezogenes Fenster. Im oberen Winkel der Reusenkonstruktion befindet sich eine 10×20 cm große Öffnung. Über diese Öffnung wird ein durchsichtiger Plastiksack gestülpt. Die aus NNE ankommenden Insekten fliegen in der Reuse, von den schräg stehenden Wänden geleitet, bis zum Fenster, steigen an ihm empor und gelangen so in den Plastikbeutel. Dieser wurde in den Jahren 1975–1977 von Sonnenaufgang bis Sonnenuntergang, ab 1978 von Sonnenaufgang bis 16 Uhr MEZ stündlich gewechselt.

Am Arbeitsplatz in der wenige Meter entfernten Station werden die Insekten betäubt und bestimmt, wobei eine Vergleichsammlung zur Verfügung steht. Nicht immer kann so eine sichere Artdiagnose gestellt werden, so daß Zweifelsfälle zur späteren Nachbestimmung gesammelt werden. Das Gros der Fänglinge überlebt die Betäubung und wird wieder in die Freiheit entlassen.

In den Jahren 1977 und 1979–1982 wurde als Kontrolle zusätzlich eine baugleiche Reuse mit einer nach S gerichteten Öffnung betrieben. In dieser Reuse gefangene Schwebfliegen wurden im Jahr 1979 nur pauschal erfaßt, in den anderen Jahren artlich getrennt ausgezählt.

Tab. 1 und Abb. 27a geben einen Überblick über Reusengröße, Zeitraum der Erfassung und Anzahl gefangener und bestimmter Schwebfliegen im Untersuchungszeitraum.

Tabelle 1: Fangzeitraum, Reusengröße und Zahl der gefangenen Schwebfliegen am Randecker Maar 1975–1987.
Tab. 1: Period of investigation, size of trap opening, and number of trapped hoverflies at Randecker Maar 1975–1987.

Jahr	Zeitraum	Reusengröße	Südflieger (S-Reuse)	Nordflieger (N-Reuse)
1975	26. 7.–30. 9.	5 m^2	4568	
1976	16. 7.–30. 8.	5 m^2	1214	
1977	22. 7.–12. 9.	5 m^2	1519	299
1978	16. 7.–14. 10.	10 m^2	6462	
1979	16. 7.–31. 10.	10 m^2	8910	1417
1980	9. 7.–10. 11.	10 m^2	8869	2091
1981	22. 7.–12. 10.	10 m^2	11511	3708
1982	18. 7.– 3. 10.	10 m^2	5323	2300
1983	—	—	—	
1984	1. 8.–10. 10.	10 m^2	7190	
1985	28. 7.– 4. 10.	10 m^2	13215	
1986	13. 7.–11. 10.	10 m^2	11971	
1987	19. 7.–23. 9.	10 m^2	9297	
12 Jahre			90049	9815

2.3 Registrierung der Wetterdaten

Jede Stunde werden folgende Wetterdaten erfaßt:

- Windrichtung (N, NE, E, SE, S, SW, W, NW) und Windstärke (in Bft.); Messung mit Hilfe eines auf der Höhe der Kuppe stehenden und über die Baumschicht hinausragenden Windmeßgerätes;
- Bedeckungsgrad des Himmels in Achteln;
- Temperatur;
- Sicht;
- Besondere Vorkommnisse wie Niederschlag, Gewitter, Nebel.

2.4 Klimadaten der Station Randecker Maar

An der in geringer Entfernung und auf ungefähr gleicher Höhe (764 m) liegenden Wetterstation Schopfloch beträgt die mittlere Jahrestemperatur 6,9 °C, der mittlere Jahresniederschlag 1 065 mm. Während der Beobachtungsperiode liegen die Mittelwerte bei 15,7 °C/120 mm im Juli, 15,2 °C/108 mm im August, 12,1 °C/93 mm im September, 7,2 °C/72 mm im Oktober und 2,6 °C/70 mm im November.

Im Albvorland (Kirchheim, 315 m) beträgt die mittlere Jahrestemperatur 9,0 °C bei einem Niederschlag von 752 mm. Der Nordrand der Schopflocher Berghalbinsel, auf der die Station liegt, gehört zu den nebelärmsten Punkten des mittleren Württemberg. Die Nebel des Albvorlandes steigen am nördlichen Steilabfall selten über 600 m NN hoch.

2.5 Abkürzungen

RM: Randecker Maar
CB: Col de Bretolet
S-Reuse: nach Norden geöffnete Reuse, die nach Süden fliegende Insekten fängt
N-Reuse: nach Süden geöffnete Reuse, die nach Norden fliegende Insekten fängt
♂: Männchen
♀: Weibchen

3. Ergebnisse

3.1 Schwebfliegenarten am Randecker Maar

Eine vollständige Artenliste der am Randecker Maar beobachteten Schwebfliegen liegt bereits vor (Schmid & Gatter 1988). Hier werden deshalb nur die Arten berücksichtigt, von denen genug Material (>50 Ex.) vorhanden ist, um gut begründbare Aussagen über ihre Phänologie zu treffen (Tab. 2).

Nach der Ernährungsweise der Larven lassen sich bei Schwebfliegen verschiedene Gruppen unterscheiden, die hier nacheinander abgehandelt werden:

– Schwebfliegen mit zoophagen (meist blattlausfressenden) Larven;

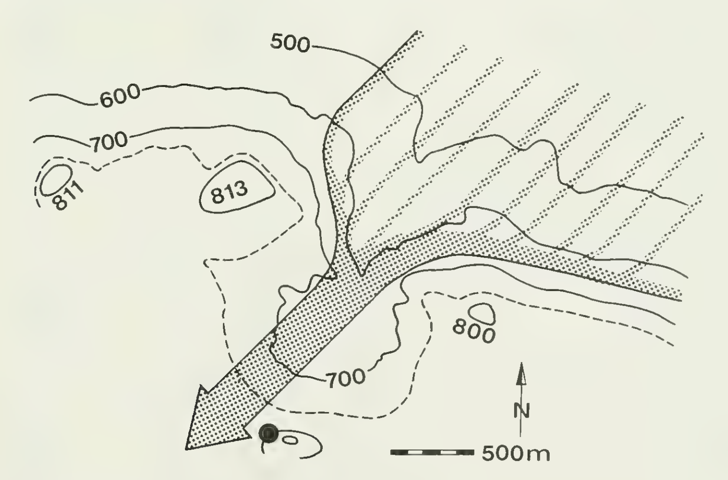


Abb. 2 a: Das nach Norden geöffnete Randecker Maar in der Aufsicht. Aus Norden und Nordosten trifft der Breitfrontzug auf den 400 m hoch über dem Vorland aufragenden Steilabfall der Schwäbischen Alb. Vögel und Insekten ziehen bevorzugt durch den Einschnitt des Maars. Der Punkt zeigt die Lage der Station (aus Gatter 1981 a).
Fig. 2 a: "Randecker Maar" in topview. Migrating birds and insects use the cleft in the 400 m steep slope of the Schwäbische Alb. The spot shows the site of the station.

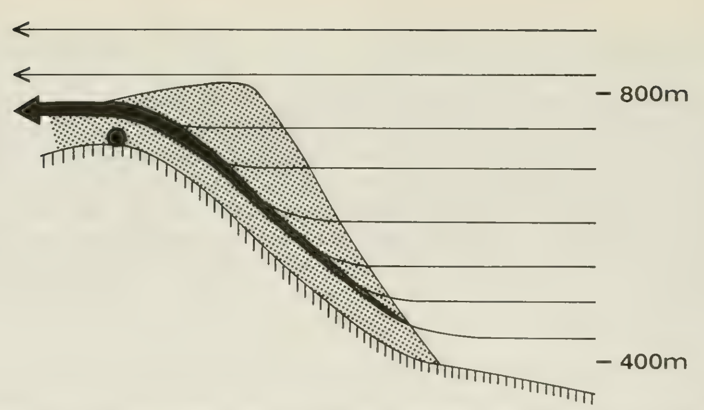


Abb. 2b: Am Steilabfall der Schwäbischen Alb (im Schnitt dargestellt) kommt es zu einer vertikalen Verdichtung des Zuggeschehens. Der Punkt zeigt die Lage der Station (aus Gatter 1981 a).
Fig. 2b: Vertical concentration of migrants passing the Randecker Maar. The spot indicates the station site.

Tabelle 2: Zwölfjährige Fangsummen einzelner Arten in der S-Reuse des Randecker Maars. Zum Vergleich sind die am Col de Bretolet in einem ebenfalls zwölfjährigen Untersuchungszeitraum (1962–1973) gewonnenen Fangsummen aufgeführt (nach Aubert et al. 1976).
Tab. 2: Total amount of hoverflies trapped in the S-trap (trap with opening to the north) at Randecker Maar during 12 years compared with the data of Col de Bretolet (1962–1973).

	Randecker Maar		Col de Bretolet	
1. *Episyrphus balteatus*	29546	32,81%	1264568	52,77%
2. *Melanostoma mellinum*	13937	15,48%	31573	1,32%
3. *Platycheirus clypeatus*	13450	14,94%	25	0,00%
4. *Sphaerophoria scripta*	11856	13,17%	146210	6,10%
5. *Metasyrphus corollae*	8426	9,36%	160685	6,71%
6. *Syrphus* spec.	5154	5,72%	67121	2,80%
7. *Platycheirus albimanus*	1138	1,26%	3658	0,15%
8. *Scaeva pyrastri*	885	0,98%	11168	0,47%
9. *Eristalis tenax*	757	0,84%	635294	26,51%
10. *Platycheirus manicatus*	739	0,82%	1476	0,06%
11. *Helophilus pendulus*	724	0,80%	4189	0,17%
12. *Rhingia campestris*	700	0,78%	356	0,01%
13. *Cheilosia pagana*	448	0,50%	10	0,00%
14. *Sphaerophoria menthastri* Gruppe	293	0,33%	127	0,01%
15. *Platycheirus peltatus*	272	0,30%	60	0,00%
16. *Parasyrphus lineolus*	270	0,30%	5746	0,24%
17. *Meliscaeva cinctella*	247	0,27%	1058	0,04%
18. *Helophilus trivittatus*	180	0,20%	1988	0,08%
19. *Scaeva selenitica*	171	0,19%	10806	0,45%
20. *Neoascia podagrica*	120	0,13%	0	0,00%
21. *Eristalis arbustorum*	91	0,10%	4509	0,19%
22. *Syritta pipiens*	79	0,09%	40	0,00%
23. *Eristalis interrupta*	69	0,08%	21	0,00%
24. *Eristalis pertinax*	57	0,06%	180	0,01%
25. *Melanostoma scalare*	51	0,06%	3	0,00%
Sonstige	389	0,43%	45668	1,91%
	90049	100,00%	2396539	100,00%

– Schwebfliegen mit terrestrisch lebenden, saprophagen Larven;
– Schwebfliegen mit aquatisch lebenden, sapro-/microphagen Larven;
– Schwebfliegen mit phytophagen Larven.

Innerhalb dieser Gruppen sind die Arten systematisch angeordnet.

Die Artabschnitte sind folgendermaßen gegliedert:

– Verbreitung (nach Angaben von Knutson et al. 1975, Sack 1932, Thompson et al. 1976, Violovitsh 1983, Wirth et al. 1965);
– Angaben zur Biologie: Flugzeit, Generationenfolge, Überwinterung, Häufigkeit;
– Hinweise auf Wanderverhalten;
– Phänologie am Randecker Maar;
– Status: In diesem Abschnitt wird versucht, die Art einer der bekannten Migrationsformen zuzuordnen, wobei wir die als Arbeitshypothese vorgeschlagene Gliederung von Gatter (1981a: 19–27, 1981c) zugrundelegen (vgl. Abb. 3).

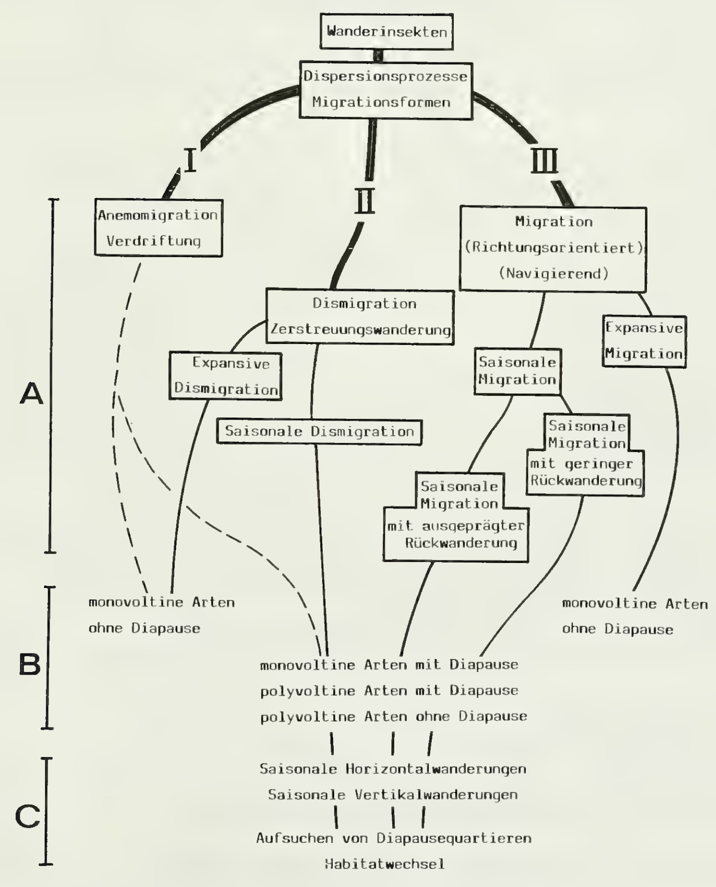


Abb. 3: Die Migrationsformen der Insekten. Die links mit Buchstaben bezeichneten Bereiche beziehen sich auf obligatorische Wanderer und bedeuten A) WIE, B) WER und C) WESHALB gewandert wird (aus Gatter 1981 a).
Fig. 3: Insect migration categories. Letters on the left mean A) HOW, B) WHO and C) WHY migration takes place.

Die Begriffsbestimmungen sollten dabei nicht als starre, restriktive Einteilung verstanden werden (Baker 1978). Als Folge der großen biologischen Mannigfaltigkeit der Insektenwanderungen bestehen zahlreiche Übergänge zwischen einzelnen Migrationsformen (vgl. 4.5.4):

I. Anemomigration (Verdriftung): Passive Verfrachtung flugbereiter Insekten durch den Wind ohne Richtungsorientierung.

II. Dismigration (Zerstreuungswanderung): Endogen (dispersal) oder exogen (spacing) ausgelöste aktive Zerstreuungswanderungen ohne bzw. mit nur geringer Richtungsorientierung durch Selektion günstiger Winde.
Innerhalb der Dismigrationen können zwei verschiedene Formen unterschieden werden:

II.1 Expansive Dismigration (Expansive Zerstreuungswanderung): Aktive Zerstreuungswanderung nicht oder nur indirekt richtungsorientiert wandernder Arten, die sich bei der Migration vom Entwicklungsort entfernen. Sie und ihre Nachkommen kehren nicht zurück.

II.2 Saisonale Dismigration (Saisonale Zerstreuungswanderung): Aktive saisonale Wanderung nicht oder nur indirekt richtungsorientiert wandernder Arten in Sommer- bzw. Winterareale oder Diapausequartiere und zurück. Durch saisonal unterschiedliche Winde (ohne Richtungsorientierung) oder Selektion günstiger Winde (indirekte Richtungsorientierung) können saisonal unterschiedliche Hauptstoßrichtungen entstehen.

III. Migration (richtungsorientiert) (Richtungsorientierte Wanderung): Wanderungen von Individuen oder Populationen von Arten mit endogen programmierter Migrationsrichtung (kompaßorientiert).

III.1 Expansive Migration (Expansive richtungsorientierte Wanderung): Richtungsorientiert wandernde Arten, die sich auch ohne Einfluß exogener Faktoren vom Entwicklungsort weg in eine Vorzugsrichtung entfernen. Sie und ihre Nachkommen kehren nicht zurück.

III.2 Saisonale Migration (Richtungsorientierte Saisonwanderung): Richtungsorientierte Wanderungen in Sommer- oder Winterareale bzw. Diapausequartiere (Sommer- und Winterruhe) und zurück, die von Individuen oder Populationen einer Art alljährlich ausgeführt werden.

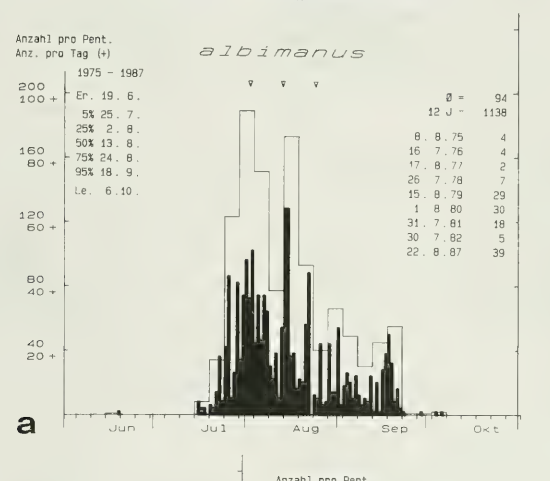
Unter den Schwebfliegen fehlen Beispiele für reine Anemomigration und für Expansive Migration.
Ein Beispiel für eine Expansive Dismigration ist *Volucella zonaria* (vgl. 3.2.3).
Zahlreiche Syrphidenarten führen Saisonale Dismigrationen oder Saisonale Migrationen durch. Saisonale Zerstreuungswanderungen stehen oft in sehr engem Zusammenhang mit dem Entwicklungszyklus einer Art. Sie dienen dabei neben dem Aufsuchen von Winter- oder Sommerarealen und von Diapausequartieren auch dem Aufsuchen von Orten, die der Nachfolgegeneration günstige Entwicklungsbedingungen bieten. Treten z. B. Nahrungsressourcen, von denen die Larven einer Art abhängig sind, nicht gleichmäßig in Raum und Zeit auf (z. B. Blattläuse), können sie durch saisonal dismigrierende Arten schneller und effektiver erschlossen werden.
Dismigrationen können von ganzen oder nur von Teilpopulationen durchgeführt werden; bei Migrationen sind in vielen Fällen eher ganze Populationen beteiligt.
Saisonal unterschiedliche Winde oder Selektion günstiger Winde können saisonal unterschiedliche Hauptstoßrichtungen entstehen lassen (bei Dismigrationen) oder solche unterstützen (bei Migrationen).

3.1.1 Schwebfliegen mit zoophagen Larven

Platycheirus albimanus (Fabricius 1781) (= *cyaneus* Müller 1764)

Verbreitung: holarktisch, orientalisch (Nepal?, Indien?, Philippinen)
Biologie: *Platycheirus albimanus* ist eine weit verbreitete und häufige Schwebfliegenart, die in vielen Lebensräumen angetroffen werden kann, wenn sie auch feuchtere Standorte mit dichtem Pflanzenwuchs bevorzugt. Sie ist in Mitteleuropa von (Ende März) Mitte April bis Mitte Oktober (Anfang

November) anzutreffen und bildet in Süddeutschland (Schmid 1986) wie in Großbritannien (Stubbs & Falk 1983) drei Generationen. Die Larven sind meist in der Streuschicht und nur relativ selten an Blattlauskolonien anzutreffen. Vermutlich leben sie dort zoophag mit weitem Beutespektrum (Rotheray & Gilbert 1989). *P. albimanus* überwintert als diapausierende Larve.



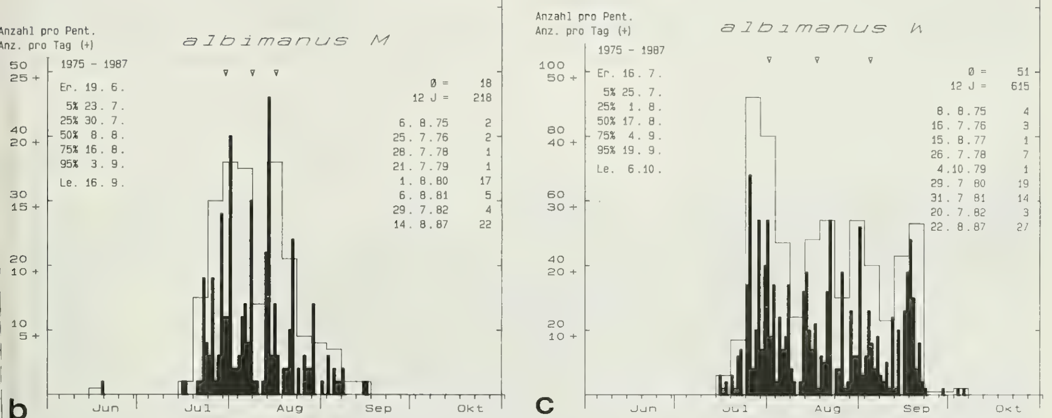


Abb. 4a: Nach Süden gerichtete Migration von *Platycheirus albimanus* in den 12 Jahren 1975–1982 und 1984–1987 in Tages- und Pentadensummen (1.–5. Jan., 6.–10. Jan. etc.). Auf der Ordinate werden Tagessummen (untere Zahl, mit + markiert) und Pentadensummen (obere Zahl) angegeben. An welchem Tag 5, 25, 50, 75 und 95 % der Gesamtsumme durchgezogen sind, kann links oben abgelesen werden. Die dreieckigen Pfeile über dem Diagramm kennzeichnen die Lage der 25 %-, 50 %- und 75 %-Werte. Rechts oben kann die Zahl aller im 12jährigen Untersuchungszeitraum gefangener Tiere (n) und der Jahresdurchschnitt (∅) abgelesen werden. Darunter ist für jedes Jahr die maximale Tagessumme aufgeführt.

Fig. 4a: Migration of *Platycheirus albimanus* in southerly direction over 12 years (1975–1982; 1984–1987) with the sum of days and the sum of 5-day periods (1.–5. Jan., 6.–10. Jan. ....). Sum of days (lower number, marked with +) and sum of 5-day periods (upper number) are shown on the ordinate. On the left upper side is shown on which day 5, 25, 50, 75 or 95 % of total have passed. The triangles show the position of 25 %, 50 % and 75 % values. Above on the right the total number of trapped *P. albimanus* (n), the annual average (∅) and of each year the day with most specimens are shown.

Abb. 4b: Nach Süden gerichtete Migration von *Platycheirus albimanus*-♂♂.

Fig. 4b: Southbound migration of ♂♂ of *Platycheirus albimanus.*

Abb. 4c: Nach Süden gerichtete Migration von *Platycheirus albimanus*-♀♀.

Fig. 4c: Southbound migration of ♀♀ of *Platycheirus albimanus.*

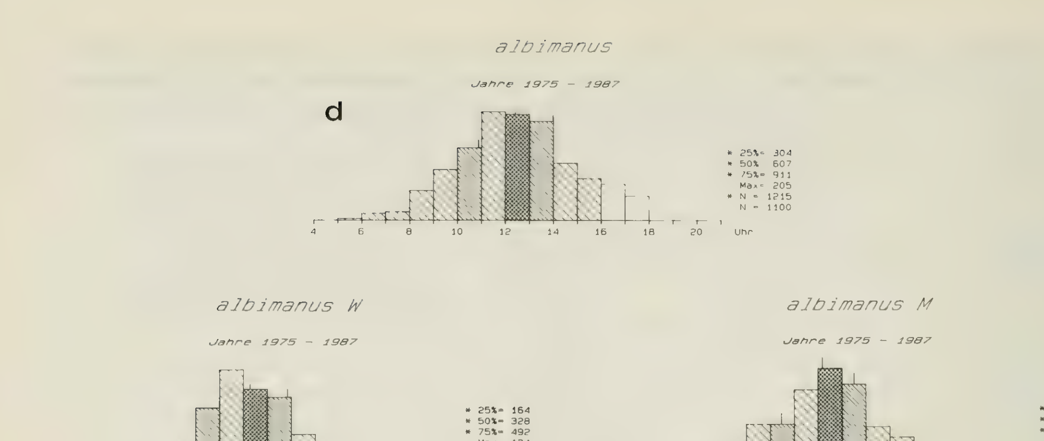


Abb. 4 d: Tageszeitliche Verteilung von *Platycheirus albimanus* nach Fängen aus der S-Reuse in den Jahren 1975–1982 und 1984–1987.

Die Stunde, die den 50%-Wert enthält, ist kreuzschraffiert, die Stunden, die die 25%- und 75%-Werte enthalten, sind eng schraffiert. Die Strichmarkierungen über diesen Säulen bezeichnen die aus Stundenwerten errechnete Lage des 25%-, 50%- und 75%-Wertes genauer. Die zugrundeliegenden, kumulierten Individuenzahlen sind rechts angegeben (* 25% etc.).

Nur in den Jahren 1975–1977 wurde von Sonnenaufgang bis Sonnenuntergang beobachtet (vgl. Abb. 8b). In den anderen Jahren endete die tägliche Beobachtungszeit um 16 Uhr. Die Zugbewegungen am Spätnachmittag wurden aus den dreijährigen Beobachtungen nach 16 Uhr hochgerechnet. Sie sind als weiße Säulen dargestellt.

N gibt die Zahl der tatsächlich gefangenen Schwebfliegen an, *N (ebenso wie alle anderen mit * versehenen Zahlen) die durch die Hochrechnung der spätnachmittäglichen Zugbewegungen modifizierte Zahl.

Zur Veranschaulichung der Zahlenverhältnisse dient der „Max"-Wert, der für die längste Säule die Zahl der in dieser Stunde gefangenen Individuen nennt.

Fig. 4d: Diurnal activity pattern of southbound migrating *Platycheirus albimanus* (1975–1982, 1984–1987). 50% of the total numbers have passed between the early morning and the hour marked by cross hatching. The hour at which 25% and 75% have passed respectively, are closely hatched. The small lines on top of the vertical bars indicate exactly the position of 25%, 50% and 75%.

Only in 1975–1977 did observations last from sunrise till sunset. In other years they ended at 4 p.m. The catches later in the afternoon (white bars) are calculated from the observations in 1975–1977. N is the real number of caught *albimanus*, *N (and other numbers with *) is a fictitious number arrived at by extrapolization of the afternoon catches from 1975–1977 over the whole period of investigation. "Max" means the number of specimens indicated by the longest bar.

Wanderungen: Obwohl die Art am Col de Bretolet in nicht geringer Zahl gefangen wurde, lassen Aubert et al. (1976) offen, ob es sich dabei um eine Wanderart handelt („considérée comme migratrice“). *P. albimanus* erscheint am CB während der ganzen Beobachtungsperiode regelmäßig, ohne daß Maxima erkennbar wären. Ein weiterer Hinweis auf Wanderungen in den Alpen findet sich nur bei Prell (1925), der während einer Insektenmigration einige Exemplare sammelte. Aus Norddeutschland liegen Nachweise nicht bodenständiger Individuen von der Insel Scharhörn (Schmid 1987) und von Feuerschiffen vor (Heydemann 1967). Unter Belegexemplaren wandernder Schwebfliegen aus Südengland war auch ein *albimanus*-♀ (Parmenter 1960).

Phänologie am Randecker Maar: Hier erscheint die Art in den meisten Jahren in – gemessen an ihrer Häufigkeit – sehr bescheidenem Ausmaß in den Reusen (Tab. 2, Abb. 4a). Auch wenn man davon ausgeht, daß die Spätsommergeneration weniger zahlenstark ist als die Frühlings- und die Sommergeneration (Schmid 1986), kann man das als Hinweis darauf deuten, daß wohl keine regelmäßigen weitreichenden Wanderungen der ganzen oder erheblicher Teile der Population stattfinden. In der S-Reuse wurden erheblich mehr *albimanus* gefangen als in der N-Reuse (3,3:1; n = 740). Die Analyse der Windrichtungen an Hauptflugtagen zeigt, daß *albimanus* zu einem erheblichen Teil bei Gegenwinden aus SW, S oder SE (59,1 %) in die S-Reuse fliegt, während bei Rückenwinden aus NW, N oder NE weniger Tiere gefangen werden (12,9 %) (Abb. 26h).

Während die Flugzeit der ♂♂ Ende August schon fast vorüber ist, werden ♀♀ durch den ganzen September hindurch gefangen (Abb. 4b, 4c). Insgesamt treten ♂♂ wesentlich spärlicher auf als ♀♀ (♂♂ : ♀♀ = 1:2,8; n = 833).

P. albimanus ist eine Art, die hauptsächlich um die Mittagszeit gefangen wird (Abb. 4d). Knapp die Hälfte gerät zwischen 11 und 14 Uhr in die S-Reuse.

Status: Saisonaler Dismigrant.

Hauptsächlich ♀♀ führen im Zusammenhang mit der Suche nach Eiablageplätzen Wanderungen aus.



Platycheirus clypeatus ♂ (Ph.: U. Schmid)

Platycheirus clypeatus (Meigen 1822)

Verbreitung: holarktisch

Biologie: *Platycheirus clypeatus* ist eine meist häufige, eurytope Art, die sich zu einem großen Anteil von Pollen blühender Gräser ernährt. Die Flugzeit beginnt (Anfang April) Anfang Mai und endet Anfang (Ende) Oktober. Innerhalb der Flugzeit werden mehrere Generationen gebildet. Die Larve überwintert. Auch *clypeatus*-Larven werden nur selten an Blattlauskolonien gesehen. Meist werden sie in der Streuschicht gefunden, wo sie vermutlich als unspezialisierte Prädatoren von Bodenarthropoden leben (Rotheray & Gilbert 1989).

Wanderungen: Zum Wanderverhalten dieser Art gibt es bisher nur wenige Beobachtungen, die überwiegend aus dem Küstenbereich stammen. Bei starkem Südwind (6 Bft.) und Temperaturen bis zu 24 °C erschienen Tausende von Tieren mit dem Wind auf der 15 km nördlich der niedersächsischen Küste liegenden und nur 14 ha großen Düneninsel Scharhörn (Schmid 1987). Lucas (in litt., 24.1.1988) fand im Spülsaum der holländischen Küste bei 's Gravenzande am 29.8.1987 neben den Saisonwanderern *Syrphus torvus, Metasyrphus corollae* und *Episyrphus balteatus* auch 2 Exemplare von *clypeatus.* Auf dem Feuerschiff „Fehmarn-Belt" wurden innerhalb drei Wochen im Juli/August 20 Exemplare gefangen (Heydemann 1967). Dagegen gerieten am CB im Verlauf von zwölf Jahren lediglich 25 *clypeatus* in die Reuse (Aubert et al. 1976).

Phänologie am Randecker Maar: *P. clypeatus* ist nach *Episyrphus balteatus* und *Melanostoma mellinum* die dritthäufigste Art in der S-Reuse (Tab. 2). Sie zeigt ein sehr deutliches Maximum im August (Abb. 5a) mit Median am 10.8. Die Verteilungskurve ist nahezu symmetrisch. Aus den Diagrammen einzelner Jahre (Abb. 5b) wird deutlich, daß sie im Einzelfall zwar erheblich vom Summendiagramm

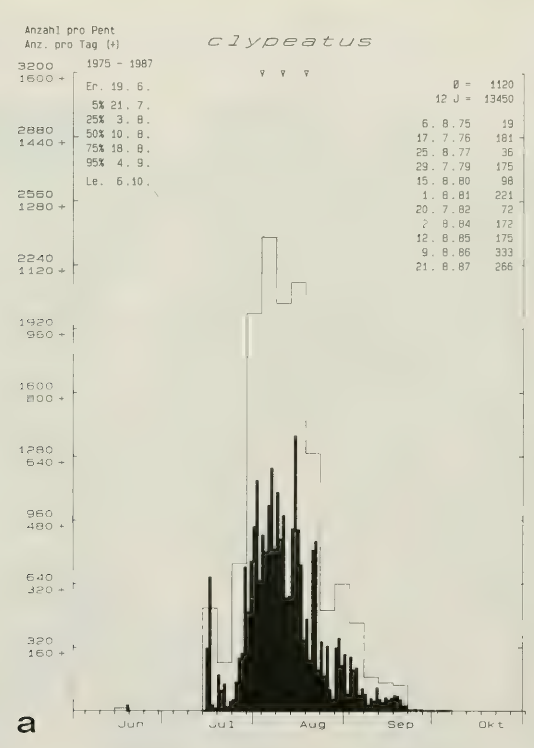


Abb. 5a: Nach Süden gerichtete Migration von *Platycheirus clypeatus* (vgl. Legende zu Abb. 4a).
Fig. 5 a: Southbound migration of *Platycheirus clypeatus*.

abweichen können, insbesondere, wenn nur wenige Tiere gefangen wurden. Das Grundmuster mit dem ausgeprägten Maximum Mitte August ist aber fast immer deutlich erkennbar.

Das Geschlechterverhältnis ist ausgeglichen (♂♂ : ♀♀ = 1:1,1; n = 10968). Im jahreszeitlichen Auftreten der beiden Geschlechter liegt der Unterschied vor allem im weitgehenden Fehlen der ♂♂ im September. Deshalb liegt der Median der ♂♂ (10. 8.) etwas früher als der der ♀♀ (15. 8.) (Abb. 5c, 5d).

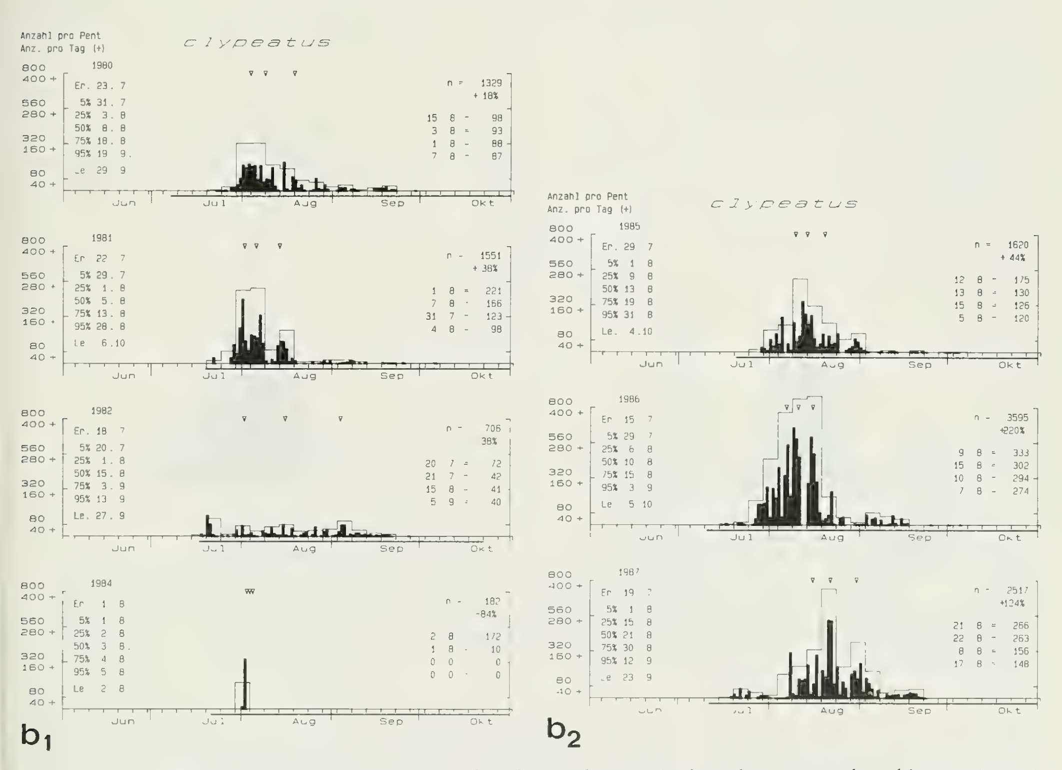


Abb. 5 b: Nach Süden gerichtete Migration von *Platycheirus clypeatus* in den Jahren 1980 (oben) bis 1987 (unten) in Tages- und Pentadensummen (1.–5. Jan., 6.–10. Jan. etc.). Auf der Ordinate werden Tagessummen (untere Zahl, mit + markiert) und Pentadensummen (obere Zahl) angegeben. An welchem Tag 5, 25, 50, 75 und 95% der Gesamtsumme durchgezogen sind, kann links oben abgelesen werden. Die dreieckigen Pfeile über dem Diagramm kennzeichnen die Lage der 25%-, 50%- und 75%-Werte.
Rechts oben wird die Jahressumme (n) und ihr Abweichen vom 12jährigen Mittelwert (in %) ausgewiesen. Die darunter aufgeführten vier stärksten Zugtage erleichtern eine Orientierung im Diagramm.
Fig. 5b: Southbound migration of *Platycheirus clypeatus* in the years 1980 (above) to 1987 (below) with the sum of days and the sum of 5-day periods (see legend of Fig. 4a). On the upper right side the total number of specimens in each year (n), its deviation from the 12-year-average (in %) and the four days of the year with most migrating specimens are shown.

Das tageszeitliche Fangmuster von *clypeatus* zeigt Abb. 5e: Die Art weist demnach bei nahezu gleichmäßiger Verteilung einen typischen Höhepunkt am frühen Nachmittag auf. (Die nach Fängen von 1975–77 extrapolierten Spätnachmittagsdaten nach 16 Uhr sind im Diagramm mit Sicherheit unterrepräsentiert.) Dieses Muster ist durchgängig zu beobachten (Abb. 5h). Ein geschlechtsspezifischer Unterschied besteht in der längeren Aktivitätsphase der ♂♂ gegenüber einem deutlicheren nachmittäglichen Aktivitätsmaximum der ♀♀ (Abb. 5f und 5g).

Abb. 5c: Nach Süden gerichtete Migration von *Platycheirus clypeatus*-♂♂ (vgl. Legende zu Abb. 4a).
Fig. 5c: Southbound migration of ♂♂ of *Platycheirus clypeatus.*

Abb. 5d: Nach Süden gerichtete Migration von *Platycheirus clypeatus*-♀♀ (vgl. Legende zu Abb. 4a).
Fig. 5d: Southbound migration of ♀♀ of *Platycheirus clypeatus.*

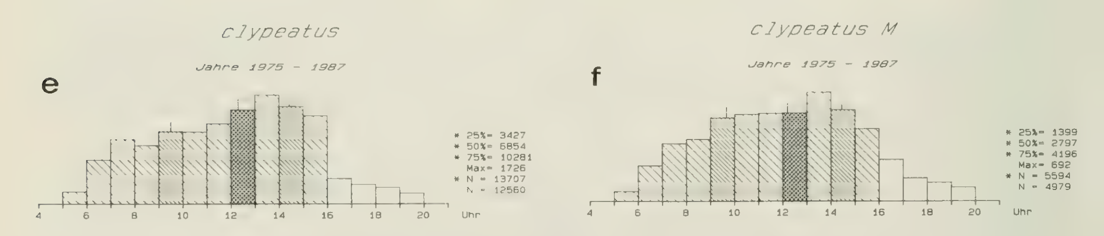


Abb. 5e: Tageszeitliche Verteilung von *Platycheirus clypeatus* (vgl. Legende zu Abb. 4d).
Fig. 5e: Diurnal activity patterns of *Platycheirus clypeatus* migrating southward.

Abb. 5f: Tageszeitliche Verteilung von *Platycheirus clypeatus*-♂♂ (vgl. Legende zu Abb. 4d).
Fig. 5f: Diurnal activity patterns of ♂♂ of *Platycheirus clypeatus* migrating southward.

Eine Analyse der Windrichtungen an den jeweils vier individuenreichsten Tagen aller Jahre (Abb. 26i) ergibt, daß 29,2 % der Fliegen bei Rückenwinden aus NW, N oder NE in die S-Reuse flogen, 55,8 % bei Gegenwinden aus SW, S oder SE (vgl. 3.4).

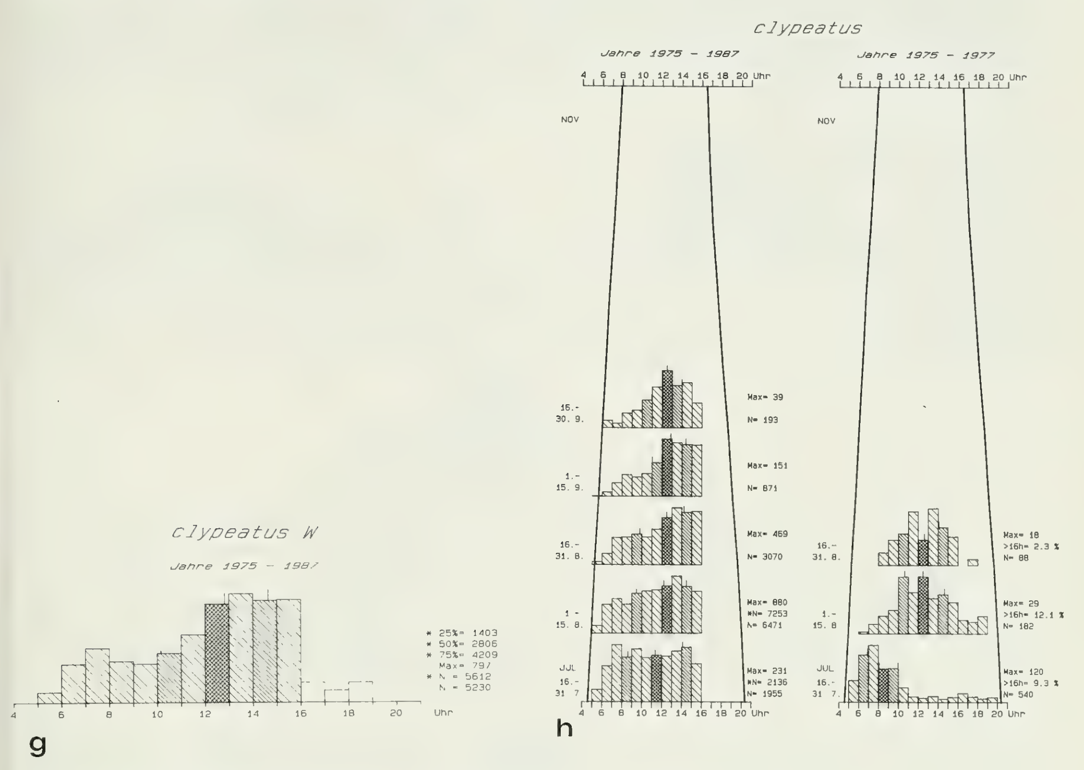


Abb. 5 g: Tageszeitliche Verteilung von *Platycheirus clypeatus*-♀♀ (vgl. Legende zu Abb. 4 d).
Fig. 5 g: Diurnal activity patterns of ♀♀ of *Platycheirus clypeatus* migrating southward.

Abb. 5 h: Tageszeitliche Verteilung von *Platycheirus clypeatus* im Jahresverlauf nach Fängen aus der S-Reuse in den Jahren 1975–1977 (rechts; Erfassung von der Morgen- bis zur Abenddämmerung) und 1975–1987 (links; Erfassung bis 16.00 Uhr).
Die Einzeldiagramme zeigen die tageszeitliche Verteilung der Fänge in Halbmonatswerten von Juli bis November. Die Stunde, die den 50 %-Wert enthält, ist kreuzschraffiert, die Stunden, die die 25 %- und 75 %-Werte enthalten, sind eng schraffiert. Die Strichmarkierungen über diesen Säulen bezeichnen die aus Stundenwerten errechnete Lage des 25 %-, 50 %- und 75 %-Wertes genauer. Die Höhe der Maximalwerte der Einzeldiagramme ist vereinheitlicht. Die Zahl der im betreffenden Zeitraum gefangenen Individuen (N) und der höchste Stundenwert (Max) ist jeweils rechts angegeben. Die Tageszeit ist unten aufgetragen (Abszisse). Die flankierenden Begrenzungslinien zeigen den Zeitpunkt des Sonnenauf- und Sonnenuntergangs für Stuttgart (Astronomisches Recheninstitut Heidelberg).
In der rechten Spalte ist mit >16 Uhr die Zahl der nach 16 Uhr gefangenen Fliegen angegeben. Auf dieser Basis wurden für die linke Spalte die *N-Werte hochgerechnet und die 25 %-, 50 %- und 75 %-Werte errechnet. Damit sind Schraffur und Markierungen beider Darstellungen rechnerisch und optisch vergleichbar.
Fig. 5 h: Diurnal activity patterns of *Platycheirus clypeatus* migrating southward throughout the year in 1975–1977 (on the right; observations from sunrise to sunset) and in 1975–1987 (on the left; observations till 4 p.m.) (see legend of Fig. 4 d). Each diagram shows the diurnal pattern of a fortnight between July and November. On the right, the total number of specimens (N), the number of specimens in the most frequented hour (Max) and after 4 p.m. (>16h) are shown. *N is a fictitious number arrived at by extrapolization of afternoon catches from 1975–1977 over the whole period of investigation. In all diagrams the 25 %, 50 %, and 75 % values are calculated from *N. The side lines of the columns show the time of sunrise (left) and sunset (right).

Das weitgehend ausgeglichene Verhältnis der Fangzahlen zwischen S-Reuse und N-Reuse (1,7:1; n = 5964) (Abb. 27 c) ist ein Hinweis darauf, daß *Platycheirus clypeatus* zumindest im bodennahen Bereich ohne ausgeprägte Richtungspräferenz wandert.

Status: Windabhängiger Saisonaler Dismigrant.

Die Beobachtungen aus dem Küstenbereich und vom RM zeigen, daß *clypeatus* regelmäßig und oft in großer Zahl wandert. Das Fehlen von Wanderbeobachtungen der Art in den Alpen läßt darauf schließen, daß sie nicht in der Lage ist, größere vertikale Distanzen zu überwinden.

Platycheirus manicatus (Meigen 1822)

Verbreitung: Europa, Altai

Biologie: Die eurytope Art *P. manicatus* fliegt von (Mitte) Ende April bis Ende September (Mitte Oktober) und bildet in Mittel- und Nordeuropa vermutlich zwei Generationen, wobei die Frühjahrsgeneration wesentlich zahlenstärker als die Spätsommergeneration ist. *P. manicatus* ist weit verbreitet und nicht selten. Im Larvenstadium ist *manicatus* vermutlich nicht obligatorisch, sondern fakultativ aphidophag (Chandler 1968a). Die Larve überwintert in Diapause.

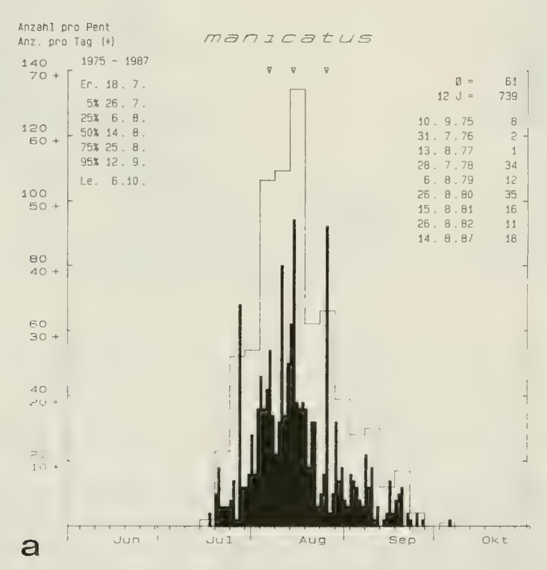


Abb. 6 a: Nach Süden gerichtete Migration von *Platycheirus manicatus* (vgl. Legende zu Abb. 4 a).
Fig. 6 a: Southbound migration of *Platycheirus manicatus.*

Wanderungen: In den Alpen ist der Status von *manicatus* unklar. Aubert et al. (1976) lassen offen, ob die Art wandert („considérée comme migratrice"). Das Fangdiagramm weist ein sehr deutliches Maximum in der letzten August- und der ersten Septemberdekade auf. Ein weiterer Hinweis auf Wanderung in den Alpen findet sich bei Burmann (1978). Funde von *manicatus* auf Feuerschiffen und Inseln (Heydemann 1967, Schmid 1987) geben Hinweise darauf, daß die Art Wandertendenzen aufweist. Auch in Südengland wurde aus wandernden Schwebfliegen ein ♂ von *manicatus* gefangen (Parmenter 1960).

Phänologie am Randecker Maar: Die Unterschiede zwischen der Anzahl der Fänge in beiden Reusen (Abb. 27d) sind bei dieser Art sehr gering (S-Reuse : N-Reuse = 1,5:1; n = 826), so daß zweifelhaft erscheint, ob *manicatus* im Herbst gerichtete Südwanderungen durchführt. Die Fangzahlen sind allerdings angesichts der Spärlichkeit der Spätsommergeneration von *P. manicatus* recht hoch (Tab. 2).

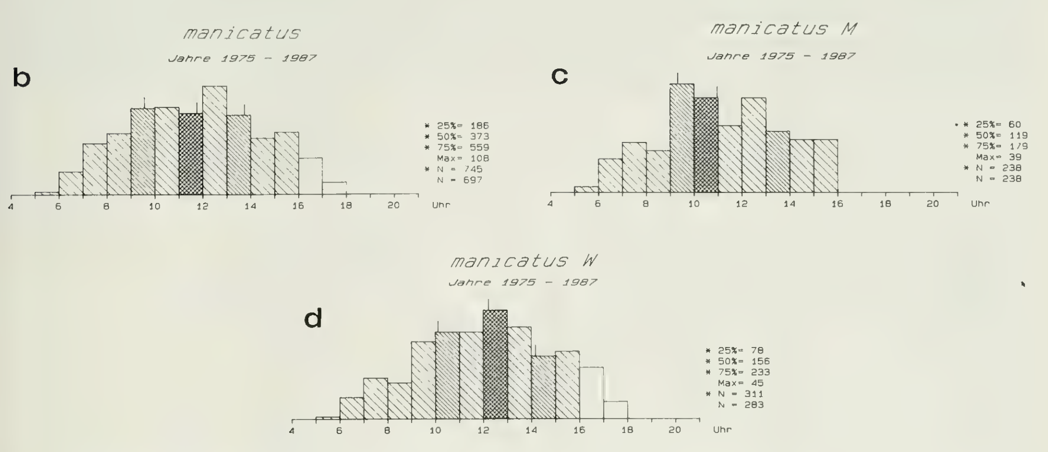


Abb. 6b: Tageszeitliche Verteilung von *Platycheirus manicatus* (vgl. Legende zu Abb. 4d).
Fig. 6b: Diurnal activity patterns of *Platycheirus manicatus* migrating southward.

Abb. 6c: Tageszeitliche Verteilung von *Platycheirus manicatus*-♂♂ (vgl. Legende zu Abb. 4d).
Fig. 6c: Diurnal activity patterns of ♂♂ of *Platycheirus manicatus* migrating southward.

Abb. 6d: Tageszeitliche Verteilung von *Platycheirus manicatus*-♀♀ (vgl. Legende zu Abb. 4d).
Fig. 6d: Diurnal activity patterns of ♀♀ of *Platycheirus manicatus* migrating southward.

Am Randecker Maar wird *P. manicatus* überwiegend im August gefangen (Abb. 6a). Die Phänologie dieser Art am RM zeigt große Ähnlichkeit mit der am CB. Der einzige Unterschied liegt in der zeitlichen Versetzung des Maximums: Mitte August am RM, Ende August/Anfang September am CB. Das Gros der ♂♂ erscheint etwas vor dem der ♀♀ (Median der ♂♂: 13.8.; Median der ♀♀: 17.8.). ♀♀ werden etwas häufiger gefangen (♂♂ : ♀♀ = 1:1,2; n = 550).

Während der wärmeren Vor- und Nachmittagsstunden gerät *P. manicatus* ziemlich gleichmäßig in die S-Reuse (Abb. 6b). Die Flugaktivität der ♂♂ ist am Vormittag deutlich höher als die der ♀♀ (Abb. 6c, 6d).

An starken Flugtagen gerät ungefähr die Hälfte (52,5 %) der Fliegen bei Gegenwind aus SW, S oder SE in die S-Reuse, ungefähr ein Viertel (24,2 %) bei Rückenwinden aus NW, N oder NE (Abb. 26k).

Status: Saisonaler Dismigrant (?).

Die gleichartige Phänologie der Art am RM und CB mit der zeitlichen Medianverschiebung zwischen RM (früher) und CB (später) lassen großräumige Wanderungen vermuten, die über den Rahmen einer Dismigration hinausgehen (vgl. 4.1). Die geringen Unterschiede zwischen beiden Reusen stellen allerdings solche weitreichenden richtungsorientierten Wanderungen der Gesamtpopulation in Frage. Auch verhält sich *manicatus* gegenüber unterschiedlichen Windrichtungen wie der typische Dismigrant *P. clypeatus* (Abb. 26i, 26k; vgl. 3.4). Vermutlich haben die Ähnlichkeiten der Phänologie am RM und CB regionale Ursachen und spiegeln nur die Flugzeit der Herbstgeneration am jeweiligen Ort wider. Um den Status dieser Art endgültig zu klären, bedarf es weiterer Beobachtungen.

Platycheirus peltatus (Meigen 1822)

Verbreitung: holarktisch

Biologie: Die Art ist weit verbreitet und zahlreich. Sie fliegt zwischen (Ende März) Mitte Mai und Mitte (Ende) Oktober mit Maxima im Mai/Juni und August/September. Die Larve ist vermutlich fakultativ aphidophag (Chandler 1968a). *P. peltatus* überwintert als Larve in Diapause.

Wanderungen: Die einzigen Hinweise auf mögliche Wanderungen stammen aus dem Küstenbereich, wo einige Individuen auf Feuerschiffen und einer Insel gefangen wurden (Heydemann 1967, Schmid 1987). In den Alpen trat *P. peltatus* nicht als Wanderer in Erscheinung (Tab. 2; Aubert et al. 1976).

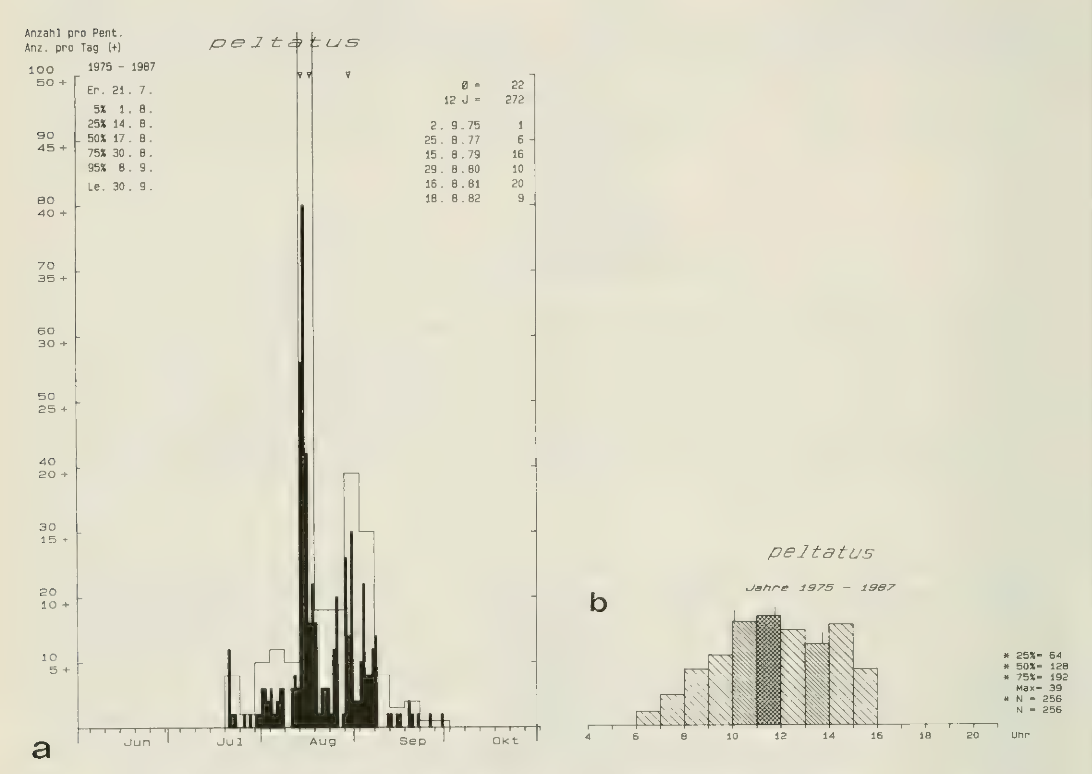


Abb. 7a: Nach Süden gerichtete Migration von *Platycheirus peltatus* (vgl. Legende zu Abb. 4a).
Fig. 7a: Southbound migration of *Platycheirus peltatus.*

Abb. 7b: Tageszeitliche Verteilung von *Platycheirus peltatus* (vgl. Legende zu Abb. 4d).
Fig. 7b: Diurnal activity patterns of *Platycheirus peltatus* migrating southward.

Phänologie am Randecker Maar: *P. peltatus* wird überwiegend im August gefangen (Abb. 7a). ♂♂ sind dabei wesentlich seltener als ♀♀ (♂♂ : ♀♀ = 1:5,8; n = 203). In der S-Reuse werden mehr *peltatus* gefangen als in der N-Reuse (3,0:1; n = 262) (Abb. 27e).

Das tageszeitliche Muster zeigt, von den frühen Morgenstunden abgesehen, eine gleichmäßig hohe Aktivität (Abb. 7b).

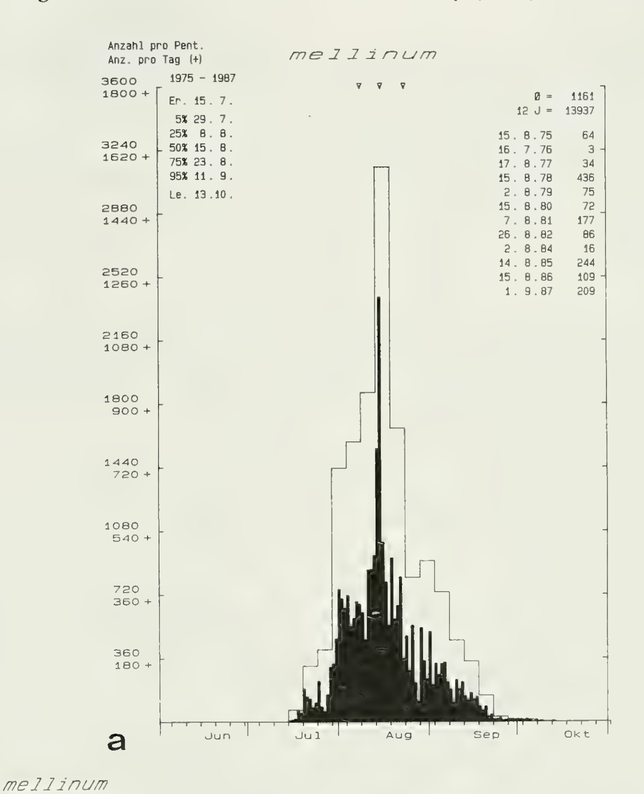
Status: Saisonaler Dismigrant.

An den bodennahen Wanderungen nehmen überwiegend ♀♀, wohl auf der Suche nach günstigen Eiablageplätzen, teil.

Melanostoma mellinum (Linnaeus 1758)

Verbreitung: holarktisch, neotropisch? (Argentinien?)

Biologie: *Melanostoma mellinum* ist eine eurytope, meist sehr häufige Art, die in Mitteleuropa von (Anfang) Mitte April bis Mitte Oktober (Mitte November) zu sehen ist. Innerhalb dieser Zeit sind oft zwei Maxima im Frühsommer und im Spätsommer zu erkennen. Die größte Häufigkeit erreicht *mellinum* im Spätsommer. *Melanostoma*-Larven sind an Blattlauskolonien relativ selten. Häufiger können sie in der Streuschicht gefunden werden (Rotheray & Gilbert 1989). Inwieweit dort auch pflanzliches Material aufgenommen wird, ist umstritten. Rotheray (1983) und Gilbert (1986) vermuteten,



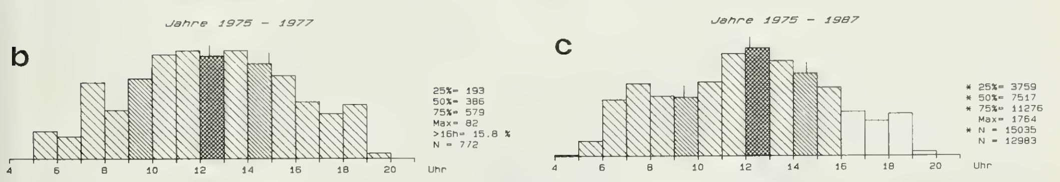


Abb. 8a: Nach Süden gerichtete Migration von *Melanostoma mellinum* (vgl. Legende zu Abb. 4a).
Fig. 8a: Southbound migration of *Melanostoma mellinum.*

Abb. 8b: Tageszeitliche Verteilung von *Melanostoma mellinum* in den Jahren 1975–1977 (vgl. Legende zu Abb. 4d).
Fig. 8b: Diurnal activity patterns of *Melanostoma mellinum* migrating southward in 1975–1977.

Abb. 8c: Tageszeitliche Verteilung von *Melanostoma mellinum* in den Jahren 1975–1987 (vgl. Legende zu Abb. 4d).
Fig. 8c: Diurnal activity patterns of *Melanostoma mellinum* migrating southward in 1975–1987.

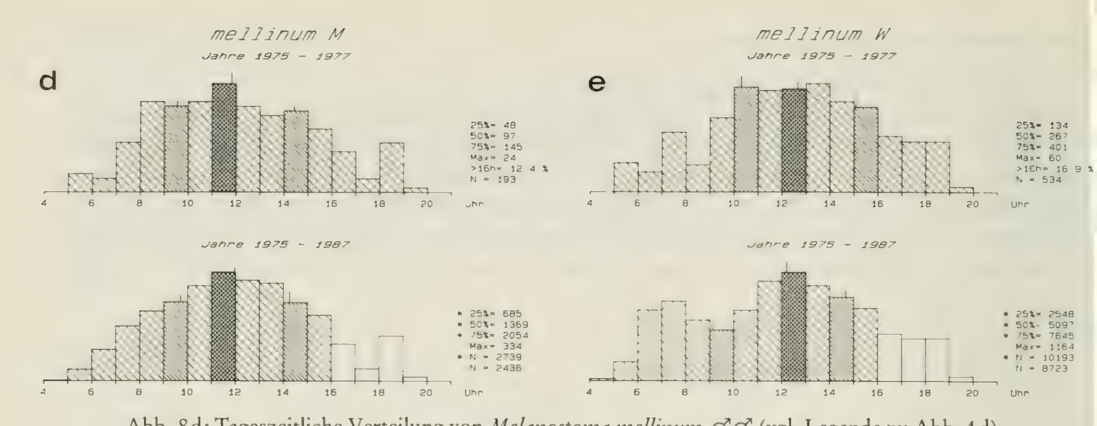


Abb. 8d: Tageszeitliche Verteilung von *Melanostoma mellinum*-♂♂ (vgl. Legende zu Abb. 4d).
Fig. 8d: Diurnal activity patterns of ♂♂ of *Melanostoma mellinum* migrating southward.

Abb. 8e: Tageszeitliche Verteilung von *Melanostoma mellinum*-♀♀ (vgl. Legende zu Abb. 4d).
Fig. 8e: Diurnal activity patterns of ♀♀ of *Melanostoma mellinum* migrating southward.

daß *mellinum*-Larven auch verrottete Blätter aufnehmen. In einer jüngeren Arbeit (Rotheray & Gilbert 1989) vertreten sie dagegen die Auffassung, daß die Art rein zoophag sei und in der Streuschicht, als Alternative zur bevorzugten Blattlausbeute, Bodenarthropoden nachstelle. Nach Bastian (1986) gehört bei Nahrungsmangel neben Schmetterlingsraupen auch pflanzliches Gewebe zum Nahrungsspektrum von *mellinum*. Die Art überwintert im Larvenstadium.

Wanderungen: Am Col de Bretolet wurde *M. mellinum* so zahlreich in den Reusen gefangen, daß Aubert et al. (1976) die Art als Wanderer bezeichnen (Tab. 2). *Mellinum* kommt dort während der ganzen Beobachtungsperiode vor. Zwischen Mitte Juli und Mitte September ist sie immer häufig, ohne daß Maxima erkennbar wären. Prell (1925) fing an einem Paß in den Vierwaldstätter Alpen während einer Insektenwanderung auch Belege von *mellinum*.

Aus dem Flachland fehlen entsprechende Beobachtungen. Angesichts der überall sehr großen Häufigkeit dieser Art sind Beobachtungen an Stellen, die nur durch Wanderung zu erreichen sind, wie z. B. Nordseeinseln ohne bodenständige Populationen und Feuerschiffe, ziemlich spärlich (Heydemann 1967, Lempke 1962, Schmid 1987).

Phänologie am Randecker Maar: *Melanostoma mellinum* ist nach *Episyrphus balteatus* die zweithäufigste in der S-Reuse gefangene Art (Tab. 2). Sie wird hauptsächlich im August gefangen und weist in diesem Monat einen starken Höhepunkt auf. Der Median liegt am 15. 8. (Abb. 8a). ♂♂ erscheinen in wesentlich geringerer Zahl als ♀♀ (♂♂ : ♀♀ = 1:3,6; n = 11974). Die Phänologie beider Geschlechter unterscheidet sich im wesentlichen nur dadurch, daß die ♂♂ (25 % am 5. 8., Median am 15. 8., 75 % am 20. 8.) etwas früher auftreten als die ♀♀ (25 % am 12. 8., Median am 16. 8., 75 % am 26. 8.).

Für *M. mellinum* ist eine ausgesprochen lange tägliche Aktivität typisch (Abb. 8b, 8c). Der im Diagramm erkennbare Gipfel in den frühen Morgenstunden geht auf das Konto der ♀♀ (Abb. 8e); die ♂♂ zeigen dagegen einen gleichmäßigen Aktivitätsanstieg bis Mittag (Abb. 8d). In der S-Reuse wurden an den vier individuenstärksten Tagen aller Jahre 64,6 % der Tiere bei Gegenwinden aus SW, S und SE gefangen, 22,3 % bei Rückenwinden aus NW, N oder NE (Abb. 26 l). Auch diese kleine und wenig flugtüchtig scheinende Art kann also durchaus gegen schwache Winde anfliegen. Sie wandert vermutlich bei Rückenwinden zu einem erheblichen Teil oberhalb des Fangbereiches der Reusen.

Die Unterschiede in den Fangzahlen zwischen S-Reuse und N-Reuse sind nicht allzu hoch (2,4:1; n = 6678) (Abb. 27f).

Status: Saisonaler Dismigrant.

Auch bei dieser Art dominieren ♀♀. Die meisten dieser ♀♀ haben fast kugelförmig angeschwollene Hinterleiber. Ihre Wanderungen dürften hauptsächlich dazu dienen, günstige Eiablageplätze zu finden (vgl. 4.4.4). Das weitgehende Fehlen dieser sehr häufigen Art an isolierten Beobachtungsstationen (z. B. Feuerschiffe) deutet darauf hin, daß ihre Wanderungen nur über kurze Distanzen führen. Da *mellinum* selbst im Bereich der alpinen Matten in großer Zahl beobachtet werden kann, können auch viele der am CB gefangenen Tiere aus der näheren Umgebung stammen.

Melanostoma scalare (Fabricius 1794)

Verbreitung: paläarktisch, orientalisch

Biologie: *Melanostoma scalare* ist, wenngleich immer noch häufig, so doch weniger zahlreich als *mellinum*. Die Art ist besonders an waldigen Standorten zu finden. Die Flugzeit stimmt mit der von *mellinum* überein. Auch *scalare* weist gewöhnlich zwei Maxima auf. Besonders häufig ist die Art im Frühjahr. Die Larve überwintert. Ihre Ernährungsweise dürfte der von *M. mellinum* entsprechen.

Wanderungen: Am Col de Bretolet wurden fast keine *scalare* gefangen (Tab. 2). Auch weitere Hinweise auf Wanderungen im Alpenraum fehlen. Aus Norddeutschland liegen einige wenige Funde nicht ansässiger Tiere von Feuerschiffen (Heydemann 1967, Lempke 1962) und von der Insel Scharhörn vor (Schmid 1987).

Phänologie am Randecker Maar: Die häufige Art wurde auch hier so selten in den Reusen gefangen (Tab. 2), daß regelmäßige Wanderungen oder gelegentliches Verdriften in größerem Ausmaß ausgeschlossen erscheint.

Status: Saisonaler Dismigrant mit sehr geringer Wanderdisposition.

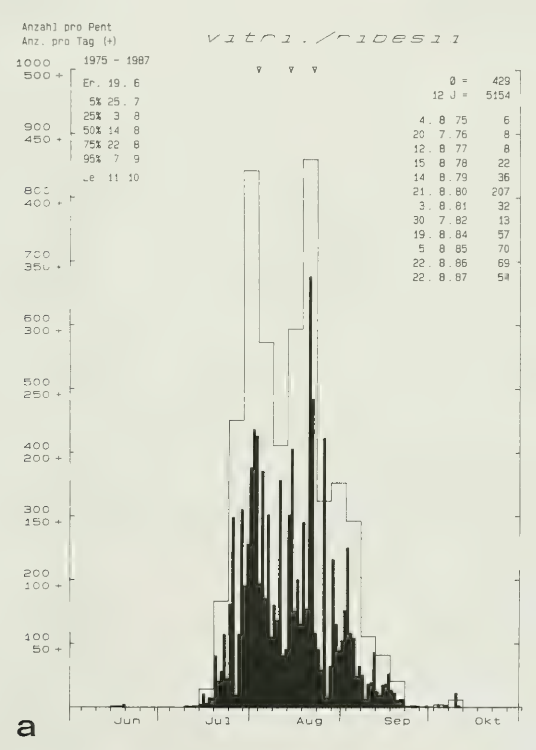


Abb. 9a: Nach Süden gerichtete Migration von *Syrphus vitripennis* und *Syrphus ribesii* (vgl. Legende zu Abb. 4a).
Fig. 9a: Southbound migration of *Syrphus vitripennis* und *Syrphus ribesii.*

Anzahl pro Pent.
Anz. pro Tag (+)

ribesii W

1975 - 1987

Er 14 7
5% 25 7
25% 1. 8.
50% 15. 8.
75% 29. 8.
95% 13 9
Le 11 10

Ø = 131
12 J = 1582

4. 8.75 4
20. 7.76 2
12 8 77 4
15 8 78 17
14 8 79 14
26. 7.80 86
31. 7.81 13
30 7 82 6
21 8 84 17
5. 8.85 15
26. 8.86 6
22 8 87 34

240 120 + 200 100 + 160 80 + 120 60 + 80 40 + 40 20 +

Jun Jul Aug Sep Okt

b

Anzahl pro Pent.
Anz. pro Tag (+)

vitripennis W

1975 - 1987

Er. 19. 6.
5% 30. 7.
25% 8. 8.
50% 21. 8.
75% 28. 8
95% 12. 9.
Le. 10.10.

Ø = 87
12 J = 1046

14. 8.75 4
23. 8.76 4
25 8.77 1
15. 8.78 9
14. 8.79 28
17. 9.80 5
3. 8.81 17
30. 7.82 8
21. 8.84 37
5. 8.85 38
26. 8.86 53
22. 7.87 3

300 150 + 270 135 + 240 120 + 210 105 + 180 90 + 150 75 + 120 60 + 90 45 + 60 30 + 30 15 +

Jun Jul Aug Sep Okt

c

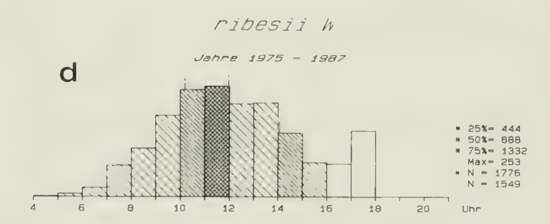


Abb. 9b: Nach Süden gerichtete Migration von *Syrphus ribesii*-♀♀ (vgl. Legende zu Abb. 4a).
Fig. 9b: Southbound migration of ♀♀ of *Syrphus ribesii.*

Abb. 9c: Nach Süden gerichtete Migration von *Syrphus vitripennis*-♀♀ (vgl. Legende zu Abb. 4a).
Fig. 9c: Southbound migration of ♀♀ of *Syrphus vitripennis.*

Abb. 9d: Tageszeitliche Verteilung von *Syrphus ribesii*-♀♀ (vgl. Legende zu Abb. 4d).
Fig. 9d: Diurnal activity patterns of ♀♀ of *Syrphus ribesii* migrating southward.

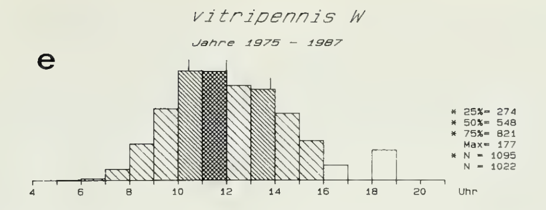


Abb. 9e: Tageszeitliche Verteilung von *Syrphus vitripennis*-♀♀ (vgl. Legende zu Abb. 4d).
Fig. 9e: Diurnal activity patterns of ♀♀ of *Syyrphus vitripennis* migrating southward.

Syrphus ribesii (Linnaeus 1758)
Syrphus torvus Osten Sacken 1875
Syrphus vitripennis Meigen 1822

In den meisten Jahren wurde nur aufgrund der bei Sack (1932) genannten Kennzeichen zwischen den *Syrphus*-Arten unterschieden. Die ♂♂ des Artenpaares *ribesii/vitripennis* sind damit aber nicht zuverlässig zu unterscheiden. Die drei häufigeren *Syrphus*-Arten werden deshalb hier gemeinsam abgehandelt. *Syrphus ribesii* und *S. vitripennis* dürften am RM in ungefähr gleich großer Häufigkeit vorkommen, *Syrphus torvus* ist hier wesentlich seltener.

Verbreitung: *ribesii:* holarktisch; *torvus:* holarktisch, orientalisch (Indien, Nepal, Thailand, Formosa); *vitripennis:* holarktisch, orientalisch (Formosa).

Biologie: Alle drei Arten sind weit verbreitet und gehören in vielen Jahren zu den häufigsten Schwebfliegenarten. Sie sind eurytop, wobei *torvus* seinen Schwerpunkt in Waldbiotopen hat. Sie überwintern als Diapause-Larven. Der Lebenszyklus von *ribesii* wurde von Schneider (1948) nach Daten aus der Schweiz genauer dargestellt: demnach können Imagines zwischen Mitte April (in Belgien Mitte März; Verlinden & Decleer 1987) und Mitte November gesehen werden. In dieser Zeit werden maximal vier Generationen gebildet. Meist treten jedoch nur zwei bis drei Generationen auf, weil ein Teil der Altlarven – im Frühjahr weniger, im Herbst immer mehr – in Diapause geht. Insgesamt ergibt sich so eine lange Flugzeit mit Maxima im Frühjahr und im Frühherbst.

Für *S. torvus* (Flugzeit [Mitte März] Anfang April bis Mitte Oktober) und *S. vitripennis* (Flugzeit [Ende März] Mitte April bis Mitte Oktober [Ende November]) sind ähnliche Verhältnisse zu erwarten.

Syrphus-Larven sind aphidophag mit einem weiten Beutespektrum (Láska & Starý 1980) und sowohl auf Bäumen als auch an Büschen und Kräutern zu finden (Dixon 1960, Rotheray & Gilbert 1989).

Wanderungen: Gatter (1980) beobachtete im Mai 1979 im Himalaya nordwärts gerichtete Dipterenwanderungen über einen 5400 m hohen Paß. Unter den 15 gesammelten Belegexemplaren gehörten 6 zur Gattung *Syrphus* (4 *S. ribesii*). Zahlreiche Beobachtungen von sommerlichen Südwanderungen liegen von allen drei Arten sowohl aus dem Gebirge (Alpen: Aubert et al. 1976, Burmann 1978, Gepp 1975, Jeekel & Overbeek 1968; Pyrenäen: Snow & Ross 1952, Williams et al. 1956) als auch von Feuerschiffen und von den Küsten vor (Heydemann 1967, Lempke 1962, Mackworth-Praed 1929, Overgaard Nielsen 1968, Schmid 1987). *Syrphus ribesii* ist sogar von Spitzbergen nachgewiesen (Elton 1925). Ein ganzer Schwarm von *ribesii* wurde am 5.8.1957 nachts 200 km vom dänischen Festland entfernt von einem hell erleuchteten Fischereiboot angezogen. „Die Menge der einfallenden Fliegen war so groß, daß sie eine heftige Belästigung der auf dem Deck arbeitenden Mannschaft ... darstellten" (Weidner 1958). Auch in Lichtfallen auf Helgoland war *ribesii* mit Abstand die häufigste Schwebfliegenart (Gatter 1981a: 67).

Alle drei Arten wurden von Aubert et al. (1976) als Wanderer eingestuft.

Phänologie am Randecker Maar: Die *Syrphus*-Arten werden hauptsächlich im August gefangen (Abb. 9a). Die deutliche Zweigipfeligkeit des Diagramms kommt durch die unterschiedlichen Zugzeiten der *Syrphus*-Arten zustande. Der erste Gipfel wird hauptsächlich von *ribesii,* der zweite von *vitripennis* gebildet. Dies zeigt ein Vergleich der Diagramme der (in allen Jahren sicher bestimmten) ♀♀ von *ribesii* und *vitripennis* (Abb. 9b, 9c) deutlich. Daß *ribesii* (Median am 15. 8.) etwas früher fliegt als *vitripennis* (Median am 21. 8.) deckt sich mit den bei Aubert et al. (1976) gezeigten Diagrammen, die für *ribesii* nach einer Zugperiode ohne deutliche Maxima eine starke Abnahme der Zahlen im September zeigen, während *vitripennis* im September das Maximum aufweist.



Syrphus ribesii ♂ (Ph. U. Schmid).

Von *vitripennis* stammen auch Fernfunde in den Alpen markierter Tiere über eine Distanz von 111 km (Aubert et al. 1969). Während in den Alpen *vitripennis* (43 832 Ex.) wesentlich häufiger ist als *ribesii* (4 047), dominiert in den Fängen am Randecker Maar die letzte Art (1 582 ausgezählte ♀♀) über die erste (1 046 ausgezählte ♀♀).

Das tageszeitliche Aktivitätsmuster beider Arten unterscheidet sich nur leicht (Abb. 9d, 9e): gegenüber *ribesii* hat *vitripennis* einen etwas späteren Aktivitätshöhepunkt. Ein Vergleich zwischen N-Reuse und S-Reuse zeigt, daß die *Syrphus*-Arten überwiegend in der S-Reuse gefangen werden (Abb. 27 g) (S-Reuse: N-Reuse = 3,6:1). Nach einer Auswertung der Windrichtungen an Hauptflugtagen fliegen 76,2 % der Tiere bei Gegenwind aus SW, S und SE in die S-Reuse und nur 7,5 % bei Rückenwind aus NW, N oder NE (Abb. 26 a).

Status: Alle drei Arten sind Saisonale Migranten.

Metasyrphus corollae (Fabricius 1794)
= *Eupeodes corollae*

Verbreitung: holarktisch, paläotropisch

Biologie: *Metasyrphus corollae* ist eine eurytope und meist häufige Art. Sie fliegt in Mitteleuropa ab (ausnahmsweise Ende März) Mitte Mai, bildet mehrere Generationen und ist bis in den Spätherbst hinein zu sehen. Selbst aus dem im Dezember existieren Beobachtungen (Schneider 1958). In Belgien ist *corollae* im Frühsommer mäßig zahlreich, erreicht dann Ende Juli sehr schnell große Abundanzen, die erst Anfang September wieder schnell nachlassen (Verlinden & Decleer 1987). *M. corollae* überwintert als Puparium (Scott 1939). Die spärlichen mitteleuropäischen Nachweise im zeitigen Frühjahr lassen vermuten, daß die Zahl der Überwinterer hier nicht sehr groß ist. Im nördlichen Mitteleuropa und Nordeuropa scheinen überhaupt keine Überwinterungsmöglichkeiten zu bestehen. Hier wandern im Frühjahr befruchtete Weibchen von Süden her ein und bauen neue Populationen auf (Torp 1984). Dementsprechend wird *corollae* hier erst spät beobachtet. In den Niederlanden, in Dänemark und in Südnorwegen erscheint die Art erst Mitte Mai (van der Goot 1981, Nielsen 1971, Torp 1984).

Die unspezialisiert aphidophagen Larven von *corollae* leben hauptsächlich an Büschen und in der Krautschicht (Dixon 1960, Láska & Starý 1980, Rotheray & Gilbert 1989).

Wanderungen: Die Nordwanderung im Frühjahr ist nicht durch direkte Beobachtungen belegt, wird aber durch das späte Erscheinen der Art im nördlichen Mitteleuropa deutlich. Dagegen existieren zahlreiche Daten zu sommerlichen und herbstlichen Wanderungsbewegungen in südliche Richtungen aus dem Gebirge wie auch von der englischen, schwedischen, dänischen und deutschen Küste (z. B. Aubert et al. 1976, Aubert & Goeldlin 1981, Gepp 1975, Heydemann 1967, Jeekel & Overbeek 1968, Johnson 1960, Johnson 1969, Lempke 1962, Overgaard Nielsen 1968, Schmid 1987, Svensson & Jan-



Metasyrphus corollae ♂ (Ph. U. Schmid).

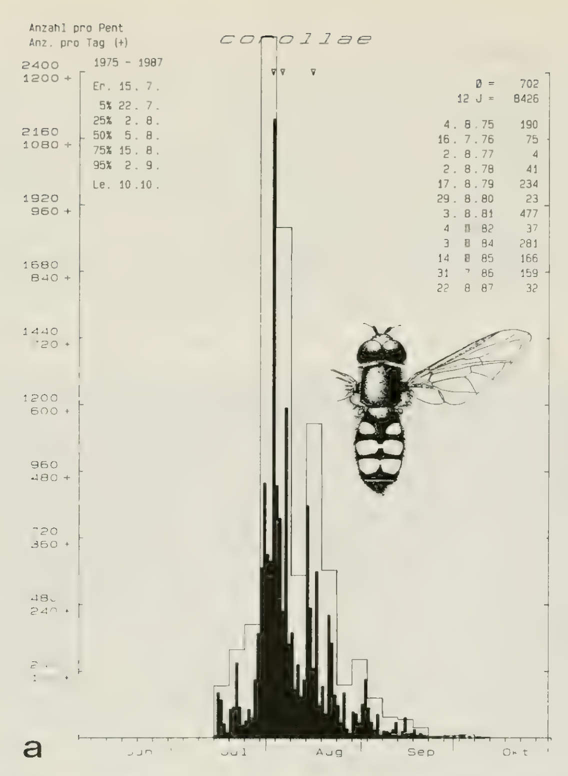


Abb. 10a: Nach Süden gerichtete Migration von *Metasyrphus corollae* (vgl. Legende zu Abb. 4a) (eingefügte Zeichnung aus van der Goot 1981).
Fig. 10a: Southbound migration of *Metasyrphus corollae*.

zon 1984, Williams et al. 1956). Sowohl im Flachland als auch im Gebirge ist *corollae* oft einer der häufigsten Wanderer. Am Col de Bretolet stellte die Art nach *Episyrphus balteatus* (52,8 %) und *Eristalis tenax* (26,5 %) mit 6,7 % die meisten Fänglinge (Tab. 2) und wurde von Aubert et al. (1976) als Wanderer eingestuft. Das Durchzugsmaximum liegt im August. Über den Wiederfang markierter Exemplare berichten Aubert & Goeldlin (1981).

Phänologie am Randecker Maar: *M. corollae* wird in großer Zahl gefangen (Tab. 2). Die Art erscheint mit einem deutlichen Schwerpunkt in der ersten Augusthälfte (Abb. 10a). ♂♂ und ♀♀ sind ungefähr gleich stark vertreten (♂♂ : ♀♀ = 1:1,1; n = 7545). Die Diagramme der beiden Geschlechter unterscheiden sich nur dadurch, daß ♀♀ in der zweiten Augusthälfte und im September etwas zahlreicher sind (Abb. 10b, 10c).

M. corollae zeichnet sich durch eine lange tageszeitliche Aktivitätsperiode mit einem leichten Schwerpunkt in den Vormittagsstunden aus (Abb. 10d). Bei ♀♀ ist dieser Vormittags-Schwerpunkt wesentlich deutlicher ausgeprägt als bei ♂♂ (Abb. 10e, 10f). Das Aktivitätsmuster ändert sich im Jahresverlauf durch die mit fortschreitender Jahreszeit zu beobachtende allmähliche Einengung der im Sommer sehr langen Phase hoher Flugintensität (Abb. 10g). Dieses Aktivitätsmuster unterscheidet sich grundsätzlich von dem von Grosser (1979) mit Hilfe von Gelbschalenfängen ermittelten. Hier lag das sehr deutliche Maximum in den ersten drei Morgenstunden (5–8 Uhr). In dieser Zeit sucht *corollae* also intensiv nach Nahrung; erst in den späteren Morgenstunden setzt dann die Migration ein.

An den Hauptflugtagen fängt sich *corollae* hauptsächlich bei Gegenwind in der S-Reuse (Abb. 26b): 75,7 % aller Fliegen geraten bei SW-, S- oder SE-Wind in diese Reuse, nur 9,2 % bei Rückenwind aus NW, N oder NE.

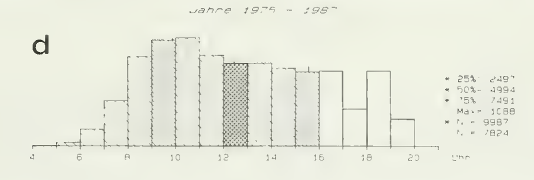


Abb. 10b: Nach Süden gerichtete Migration von *Metasyrphus corollae*-♂♂ (vgl. Legende zu Abb. 4a).
Fig. 10b: Southbound migration of ♂♂ of *Metasyrphus corollae*.

Abb. 10c: Nach Süden gerichtete Migration von *Metasyrphus corollae*-♀♀ (vgl. Legende zu Abb. 4a).
Fig. 10c: Southbound migration of ♀♀ of *Metasyrphus corollae*.

Abb. 10d: Tageszeitliche Verteilung von *Metasyrphus corollae* (vgl. Legende zu Abb. 4d).
Fig. 10d: Diurnal activity patterns of *Metasyrphus corollae* migrating southward.

Die Schwankungen der jährlichen Fangzahlen sind hoch (Abb. 27h). In den vier Jahren, in denen beide Reusen betrieben wurden, fingen sich in der S-Reuse dreimal soviel *corollae* wie in der N-Reuse (S-Reuse : N-Reuse = 3,0:1; n = 3182).

Status: Saisonaler Migrant.

Svensson & Janzon (1984) beobachteten Anfang August 1981 in S-Schweden eine Schwebfliegenwanderung, die fast ausschließlich von *M. corollae* bestritten wurde. Sie halten solche Wanderungen für unregelmäßig und exogen induziert. Demnach ermöglichte eine hohe Blattlausdichte im Jahr 1980 den Aufbau hoher Schwebfliegenpopulationen; im folgenden Jahr 1981 sollen niedrige Blattlauspopulationen die Abwanderung der Schwebfliegen erzwungen haben. Das ist mit Sicherheit für *M. corollae* nicht gültig, denn diese Art kann in Nordeuropa nicht überwintern (s. o.). Ihre Populationen sind dort

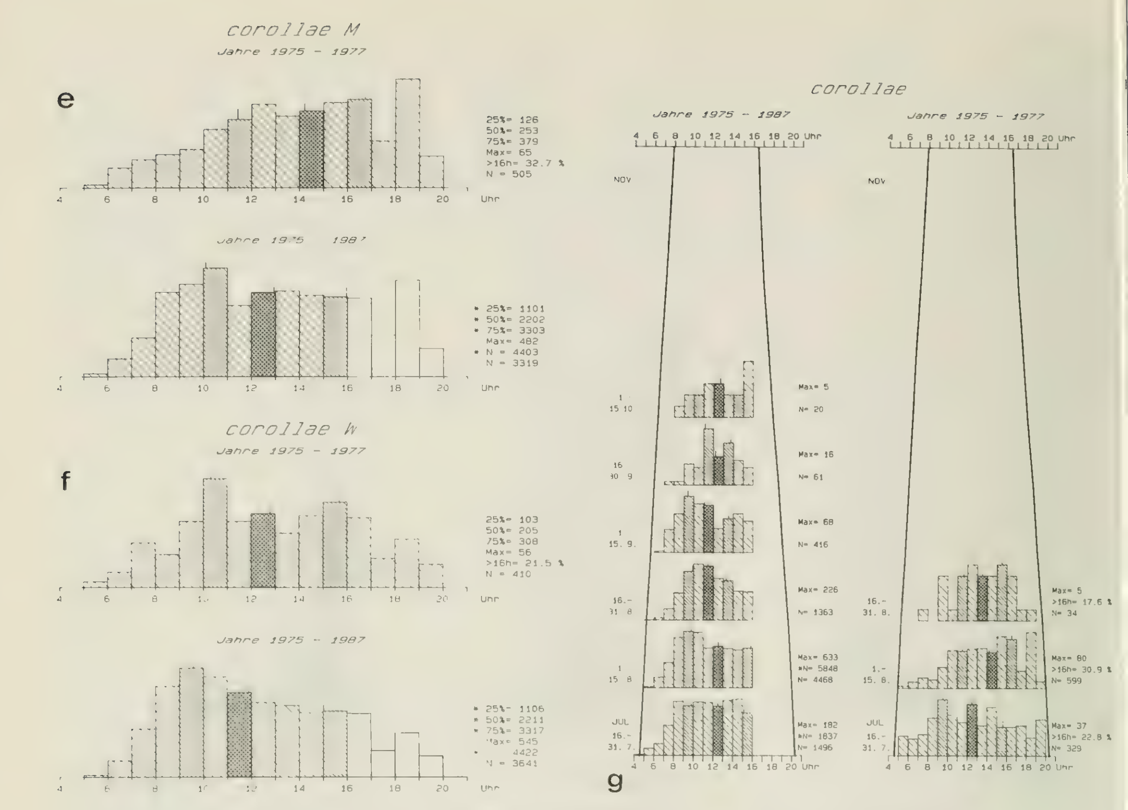


Abb. 10e: Tageszeitliche Verteilung von *Metasyrphus corollae*-♂♂ (vgl. Legende zu Abb. 4d).
Fig. 10e: Diurnal activity patterns of ♂♂ of *Metasyrphus corollae* migrating southward.

Abb. 10f: Tageszeitliche Verteilung von *Metasyrphus corollae*-♀♀ (vgl. Legende zu Abb. 4d).
Fig. 10f: Diurnal activity patterns of ♀♀ of *Metasyrphus corollae* migrating southward.

Abb 10g: Tageszeitliche Verteilung von *Metasyrphus corollae* im Jahresverlauf (vgl. Legende zu Abb. 5h).
Fig. 10g: Diurnal activity patterns of *Metasyrphus corollae* migrating southward throughout the year.

nicht von der Blattlausdichte des Vorjahrs abhängig, sondern von der Zahl der Einwanderer und der Höhe der Blattlauspopulation im selben Jahr.

Sowohl die Einwanderung in Nordeuropa im Frühjahr als auch die spätsommerlichen und herbstlichen Südwanderungen von *corollae* sind nicht exogen induziert, sondern integraler, endogen fixierter Bestandteil des Lebenszyklus dieser Art.

Scaeva pyrastri (Linnaeus 1758)

Verbreitung: holarktisch

Biologie: *S. pyrastri* ist eine polyvoltine Art, die im zentralen Europa als Imago überwintern kann (Schneider 1947, 1948, 1958, Dušek & Láska 1974). Zahlreiche Winter- und Frühlingsbeobachtungen liegen aus den Schweizer Alpen vor (Schneider l. c.). Im Mittelgebirgsraum glückt die Überwinterung wohl nur sehr selten (z. B. 1 ♀ am 8.3.1975; Kormann 1977. Je ein Februar- und Märznachweis aus Belgien; Verlinden & Decleer 1987). Gewöhnlich sieht man die Art erst ab Mitte Mai. Aus den Niederlanden gibt es einen April-Nachweis (20.4.1983, 1 ♀). Aus dem Mai liegen von dort insgesamt Nachweise von 1 ♂ (20.5.) und 15 ♀♀ (ab 4.5.) vor. Im Juni wurden 49 ♀♀ beobachtet. Erst ab An-



Scaeva pyrastri ♂ (Ph. W. Gatter).

fang Juli waren beide Geschlechter zahlreich (van der Goot 1981, 1983, 1986a). Ähnlich ist die Situation in Belgien (Verlinden & Decleer 1987): wenige Frühjahrsbeobachtungen ausschließlich weiblicher Tiere; erste ♂♂ Anfang Mai; bis Mitte Juli mäßig häufig; Ende Juli bis Ende August sehr auffälliges Maximum; Anfang September schnelles Absinken der Zahlen. In Dänemark erscheint *pyrastri* ab Ende Mai (Torp 1984), in Südnorwegen ab Ende Juni (Nielsen 1971), in Irland im Juni (Speight et al. 1975).

Es handelt sich bei *S. pyrastri* also um eine Art, bei der befruchtete ♀♀ in Zentraleuropa überwintern können. Das nördliche Mitteleuropa wird im Frühjahr durch von Süden her einwandernde Tiere besiedelt. In welchem Ausmaß *pyrastri* im zentralen und alpinen Europa überwintert, ist unklar. Ob das Herkunftsgebiet der Masse der mitteleuropäischen Einwanderer hier liegt, scheint zumindest zweifelhaft. Wahrscheinlicher ist, daß – wie auch bei *Episyrphus balteatus* (S. 44) vermutet – die Mediterraneis Haupt-Überwinterungsgebiet ist.

Die Larven von *pyrastri* sind aphidophag; sie wurden an zahlreichen Blattlausarten v. a. in der Krautschicht gefunden (Dixon 1960, Láska & Starý 1980, Rotheray & Gilbert 1989).

Wanderungen: Direkte Beobachtungen von Nordwanderungen im Frühjahr fehlen. Dagegen gibt es zahlreiche Berichte von im Sommer und Herbst in südliche Richtungen wandernden Tieren aus den Alpen, den Pyrenäen, von der Nord- und Ostseeküste und aus Süd-England (z. B. Aubert et al. 1976, Gepp 1975, Heydemann 1967, Jeekel & Overbeek 1968, Johnson 1969, Lempke 1962, Mackworth-Praed 1929, Overgaard Nielsen 1968, Schmid 1987, Walker 1864, Williams et al. 1956). Auch am Mittelgebirgsrand bei Halle (Saale) deutet eine Beobachtung auf Wanderungen von *pyrastri* hin (Grosser & Klapperstück 1976; dort allerdings durch „synchronisiertes Schlüpfen vieler Tiere" erklärt). Gele-

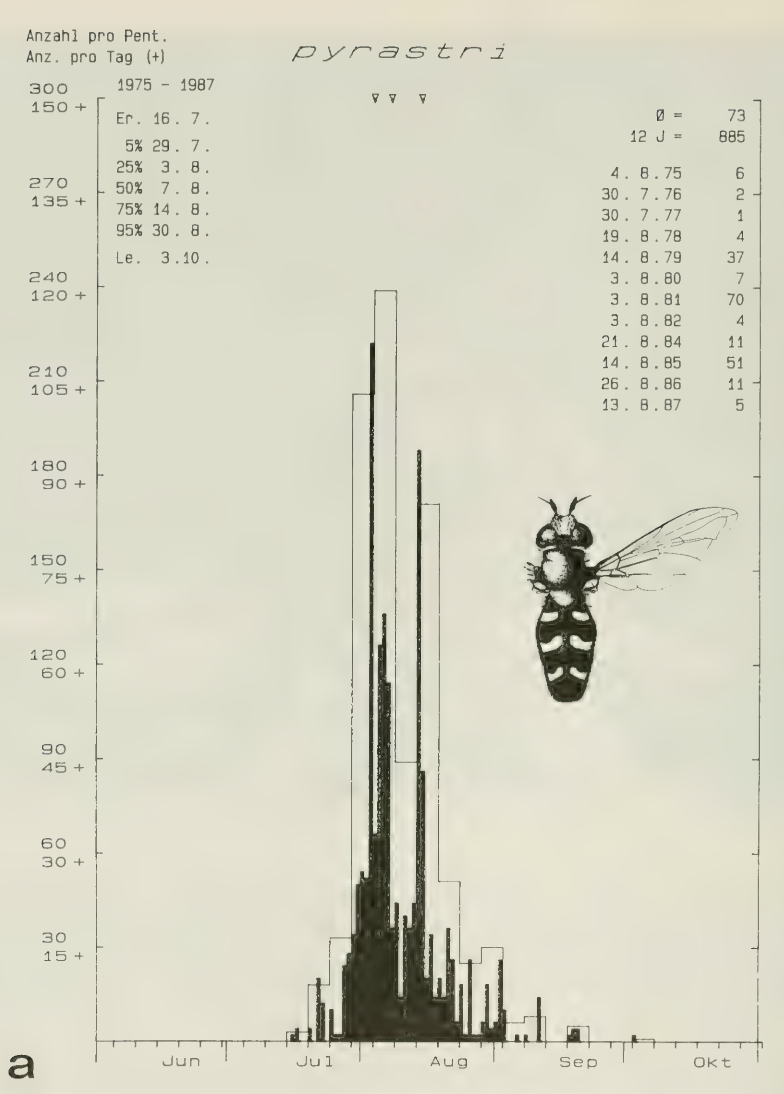


Abb. 11 a: Nach Süden gerichtete Migration von *Scaeva pyrastri* (vgl. Legende zu Abb. 4 a) (eingefügte Zeichnung aus van der Goot 1981).
Fig. 11 a: Southbound migration of *Scaeva pyrastri.*

gentlich kann es zu gewaltigen Massierungen kommen (Rogers 1864 und Symes 1864 [zitiert in Johnson 1969], Williams 1961). Am Col de Bretolet ist *pyrastri* während der ganzen Beobachtungszeit anwesend, ohne ein ausgeprägtes Maximum aufzuweisen. Von Aubert et al. (1976) wird die Art, die hier mit 11 168 Ex. 0,5 % der Fänge ausmacht (Tab. 2), als vermutlicher Wanderer geführt („espèce considérée comme migratrice").

Phänologie am Randecker Maar: Hier steht *pyrastri* mit 885 gefangenen Exemplaren an achter Stelle (Tab. 2). Die Art wurde überwiegend im August gefangen.* In der ersten Monatshälfte ist ein ausge-

* Im Jahr 1989 wanderte die Art am Randecker Maar erstmals in sehr großer Zahl. Am 16. Juli zogen hier Tausende nach Süden.

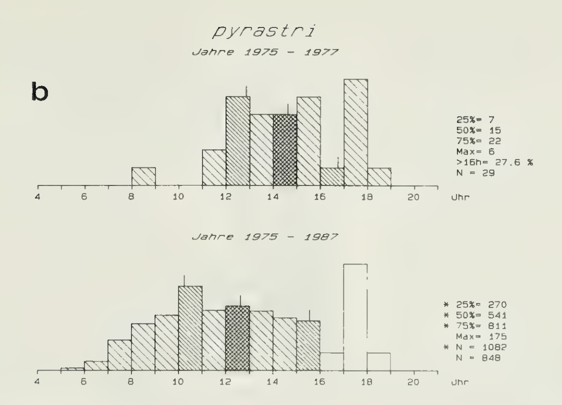


Abb. 11 b: Tageszeitliche Verteilung von *Scaeva pyrastri* (vgl. Legende zu Abb. 4 d).
Fig. 11 b: Diurnal activity patterns of *Scaeva pyrastri* migrating southward.

prägter Gipfel ausgebildet (Abb. 11a). ♀♀ erscheinen häufiger als ♂♂ (♂♂ : ♀♀ = 1:1,7; n = 654).

Das tageszeitliche Diagramm (Abb. 11b) zeigt eine nahezu symmetrische Verteilung. Der hohe Wert zwischen 17 und 18 Uhr entstand durch Hochrechnung aus den Beobachtungen der Jahre 1975–1977, als die Beobachtungen bis Sonnenuntergang durchgeführt wurden (vgl. Legende zu Abb. 4d). In diesen drei Jahren wurden insgesamt lediglich 29 *pyrastri* gefangen, davon 6 Expl. in dieser Stunde – der „Abendgipfel" existiert also in der Realität nicht.

Zwischen den beiden Reusen bestehen erhebliche Unterschiede (Abb. 27i): S-Reuse : N-Reuse = 6,0:1 (n = 341). Dabei fangen sich weitaus die meisten Tiere bei Gegenwinden aus SW, S und SE in der S-Reuse (71,8 %). Bei Rückenwinden aus NW, N und NE geraten nur 17,7 % in die Reuse (Abb. 26c).

Status: Saisonaler Migrant

Scaeva selenitica (Meigen 1822)

Verbreitung: paläarktisch, orientalisch

Biologie: Wie bei *Scaeva pyrastri* überwintern auch bei dieser weniger häufigen Art befruchtete ♀♀ (Schneider 1947, 1958). Überwinterungsmöglichkeiten finden die Imagines wieder im zentraleuropäischen und alpinen Raum und – so ist jedenfalls zu vermuten – in weiter südlich gelegenen Regionen. In den süddeutschen Mittelgebirgen kann die Art wenigstens gelegentlich ebenfalls erfolgreich überwintern (z. B. Kormann 1977), ebenso in den Niederlanden (van der Goot 1981), in Norddeutschland (Schmid 1987) und in Süd-Norwegen (Nielsen 1971). Fehlende Frühjahrsdaten aus Dänemark (Torp 1984) und Großbritannien (Stubbs & Falk 1983) zeigen, daß Überwinterungen im nördlichen Mitteleuropa eher selten sind. Auch fehlen im Norden die im südlichen Mitteleuropa üblichen (z. B. Schmid 1986, Schneider l. c.) späten Herbstbeobachtungen, die auf regelmäßige Überwinterungsversuche hinweisen könnten (späteste Daten aus Süd-Norwegen 16. 8. [Nielsen l. c.], aus Dänemark Anfang September [Torp l. c.], aus Schleswig 22. 8. [Claußen 1980]). Zum mindesten im nördlichen Mitteleuropa sind für den Aufbau der Sommerpopulationen also im wesentlichen Zuwanderer aus Süden verantwortlich. – Die blattlausfressenden Larven von *S. selenitica* wurden auf Fichten und Kiefern gefunden (Dixon 1960, Kula 1980), was die leichte Präferenz der Art für Nadelwälder erklären könnte.

Wanderungen: Am Col de Bretolet wurde *selenitica* recht zahlreich gefangen (Tab. 2) und von Aubert et al. (1976) als vermutliche Wanderart eingestuft („espèce considérée migratrice"). Die Verteilung zeigt von Anfang bis zum Ende der Erfassungszeit ein nahezu gleichmäßiges Vorkommen ohne

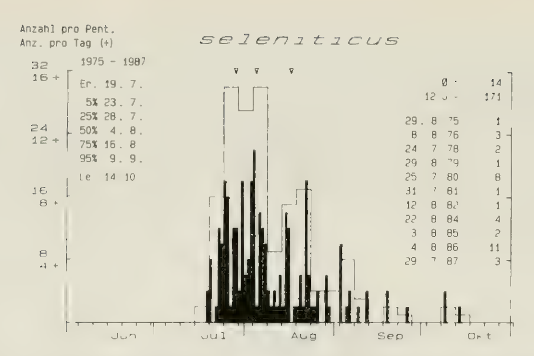


Abb. 12: Nach Süden gerichtete Migration von *Scaeva selenitica* (vgl. Legende zu Abb. 4a).
Fig. 12: Southbound migration of *Scaeva selenitica.*

Maxima oder Minima. Auch an einer in Tirol beobachteten Schwebfliegenwanderung hatte die Art teil (Jeekel & Overbeek 1968). Grey et al. (1953) sahen auch in den Pyrenäen wandernde *selenitica.*

Aus Norddeutschland liegen Funde nicht bodenständiger Individuen von der Nordseeinsel Scharhörn vor (Schmid 1987). Weitere Hinweise auf Wanderungen sind Beobachtungen von Malec (1986), daß die Art im Herbst bis in Stadtgärten komme (Umgebung von Kassel) und eigene Beobachtungen aus Innenstädten (SW-Deutschland).

Phänologie am Randecker Maar: In den meisten Jahren werden nur wenige Individuen gefangen (Abb. 27k). Dies dürfte einerseits auf die relative Seltenheit dieser Art zurückgehen, andererseits darauf, daß diese großen und flugtüchtigen Schwebfliegen die Reuse oft als Hindernis erkennen und umfliegen (Gatter 1975). *Selenitica* erscheint überwiegend im Juli und der ersten Augusthälfte (Abb. 12). Dabei stellen ♀♀ das Gros der Wanderer (♂♂ : ♀♀ = 1:2,9; n = 149). In der S-Reuse werden deutlich mehr Tiere gefangen als in der N-Reuse (S-Reuse : N-Reuse = 5,4:1; n = 54).

Status: Saisonaler Migrant.

Parasyrphus lineolus (Zetterstedt 1843)

Verbreitung: holarktisch

Biologie: Diese Art kann zwischen Ende April und Anfang Oktober beobachtet werden. Am zahlreichsten ist sie im Hochsommer. Sie ist vor allem in Wäldern und an Waldrändern zu finden. In den Nordalpen ist *lineolus* nach eigenen Beobachtungen bis über die Baumgrenze verbreitet. *Parasyrphus*-Larven leben überwiegend auf Bäumen (Rotheray & Gilbert 1989). Die aphidophagen Larven von *lineolus* wurden in Fichtenwäldern gefunden (Kula 1980).

Wanderungen: Der einzige Hinweis auf herbstliche Wanderungen stammt aus den Alpen: Aubert et al. (1976) fingen insgesamt 5746 Ex. (Tab. 2) und bezeichneten die Art, die zwischen Mitte Juli und Mitte September in fast gleichmäßigen Zahlen gefangen wird, als Wanderer.

Phänologie am Randecker Maar: *P. lineolus* fiel lediglich in zwei Jahren auf: 1980 wurden 265 Ex. in der S-Reuse und 16 Ex. in der N-Reuse, 1982 5 Ex. in der S-Reuse gefangen. Es ist möglich, daß die Art in einigen anderen Jahren ebenfalls mit wenigen Stücken vorkam, aber übersehen wurde. In den zwei Jahren, in denen *lineolus* festgestellt wurde, erschien die Art während eines eng begrenzten Zeitraums Ende Juli (Abb. 13a). Ihr Aktivitätsmaximum hat sie während der Mittagsstunden (Abb. 13b). ♀♀ überwiegen deutlich (♂♂ : ♀♀ = 1:3,0; n = 242).

Status: Saisonaler Dismigrant (Saisonaler Migrant ?).

Wahrscheinlich ist, daß die im allgemeinen eher spärlich vorkommende Art nur im Jahr 1980 hohe Populationen aufbauen konnte und in der Folge als Wanderer in Erscheinung trat. Die Abundanzen

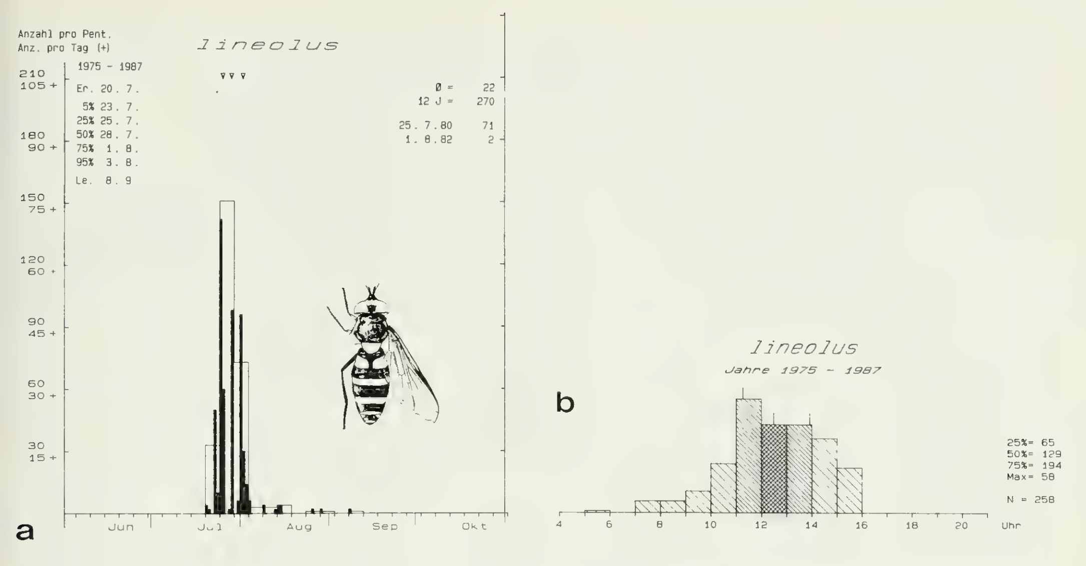


Abb. 13a: Nach Süden gerichtete Migration von *Parasyrphus lineolus* (vgl. Legende zu Abb. 4a) (eingefügte Zeichnung aus van der Goot 1981).
Fig. 13a: Southbound migration of *Parasyrphus lineolus.*
Abb. 13b: Tageszeitliche Verteilung von *Parasyrphus lineolus* (vgl. Legende zu Abb. 4d).
Fig. 13b: Diurnal activity patterns of *Parasyrphus lineolus* migrating southward.

einer Schwebfliegenart können regional sehr unterschiedlich sein. Möglicherweise sind solche räumlichen Disparitäten für die ungewöhnlich starke Konzentration auf die S-Reuse verantwortlich.

Um den Status von *P. lineolus* zu klären, sind weitere Beobachtungen notwendig.

Meliscaeva cinctella (Zetterstedt 1843)

Verbreitung: holarktisch, orientalisch

Biologie: *M. cinctella* fliegt in vielen Lebensräumen, bevorzugt aber Wälder und waldnahe Gebiete. Sie kann von (Mitte) Ende April bis Mitte Oktober beobachtet werden. Die größte Häufigkeit wird im Spätsommer erreicht. Die aphidophagen Larven von *cinctella* wurden auf Laub- und Nadelbäumen gefunden (Eiche, Apfelbaum, Holunder, Kiefer, Fichte; Rotheray & Gilbert 1989). Wie die Art überwintert, scheint noch unklar zu sein. Die nahe verwandte *Meliscaeva auricollis* (vgl. 3.2.1) überwintert als Imago (Schneider 1948).

Wanderungen: Herbstliche Wanderungen wurden bisher nur am Col de Bretolet festgestellt (Aubert et al. 1976). Obwohl die Art dort nicht sehr zahlreich erscheint (Tab. 2), wurde sie als Wanderer eingestuft. Sie weist ein sehr deutliches Maximum in der ersten Septemberhälfte auf.

Phänologie am Randecker Maar: *M. cinctella* ist in den meisten Jahren eher spärlich (Tab. 2). Nur im Jahr 1980 war sie mit 172 gefangenen Exemplaren zahlreicher. Starke Bestandsschwankungen sind bei dieser Art, wie bei anderen aphidophagen Schwebfliegen, auch andernorts beobachtet worden (z. B. Malec 1986).

M. cinctella tritt hauptsächlich im August auf (Abb. 14). Im September werden nur noch wenige Tiere gefangen. In der S-Reuse wurden wesentlich mehr *cinctella* gefangen (S-Reuse : N-Reuse = 3,5:1; n = 258). ♀♀ dominieren (♂♂ : ♀♀ = 1:3,8; n = 67).

Status: Saisonaler Migrant (?).

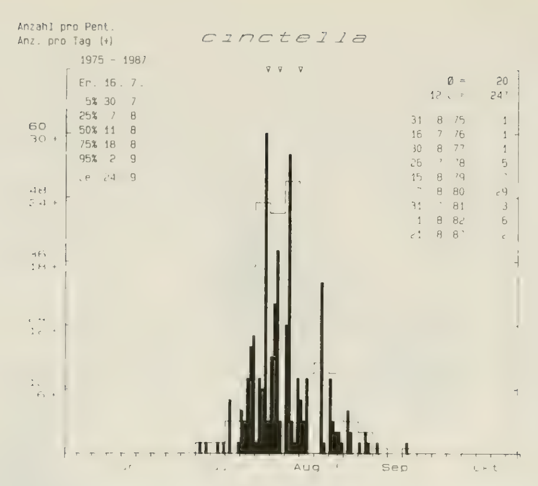


Abb. 14: Nach Süden gerichtete Migration von *Meliscaeva cinctella* (vgl. Legende zu Abb. 4 a).
Fig. 14: Southbound migration of *Meliscaeva cinctella.*

Phänologie, Geschlechterverhältnis und das häufige Vorkommen nur in einem Jahr (1980) entspricht weitgehend den Beobachtungen bei der vermutlich saisonal dismigrierenden Art *Parasyrphus lineolus* (S. 42). Der am RM und CB fast identische Verlauf der Fangkurven mit der für Saisonwanderer typischen Zeitversetzung von ca. 2–3 Wochen (vgl. 4.1) macht aber sehr wahrscheinlich, daß *cinctella* ein Saisonaler Migrant und kein Dismigrant ist.

Episyrphus balteatus (De Geer 1776)

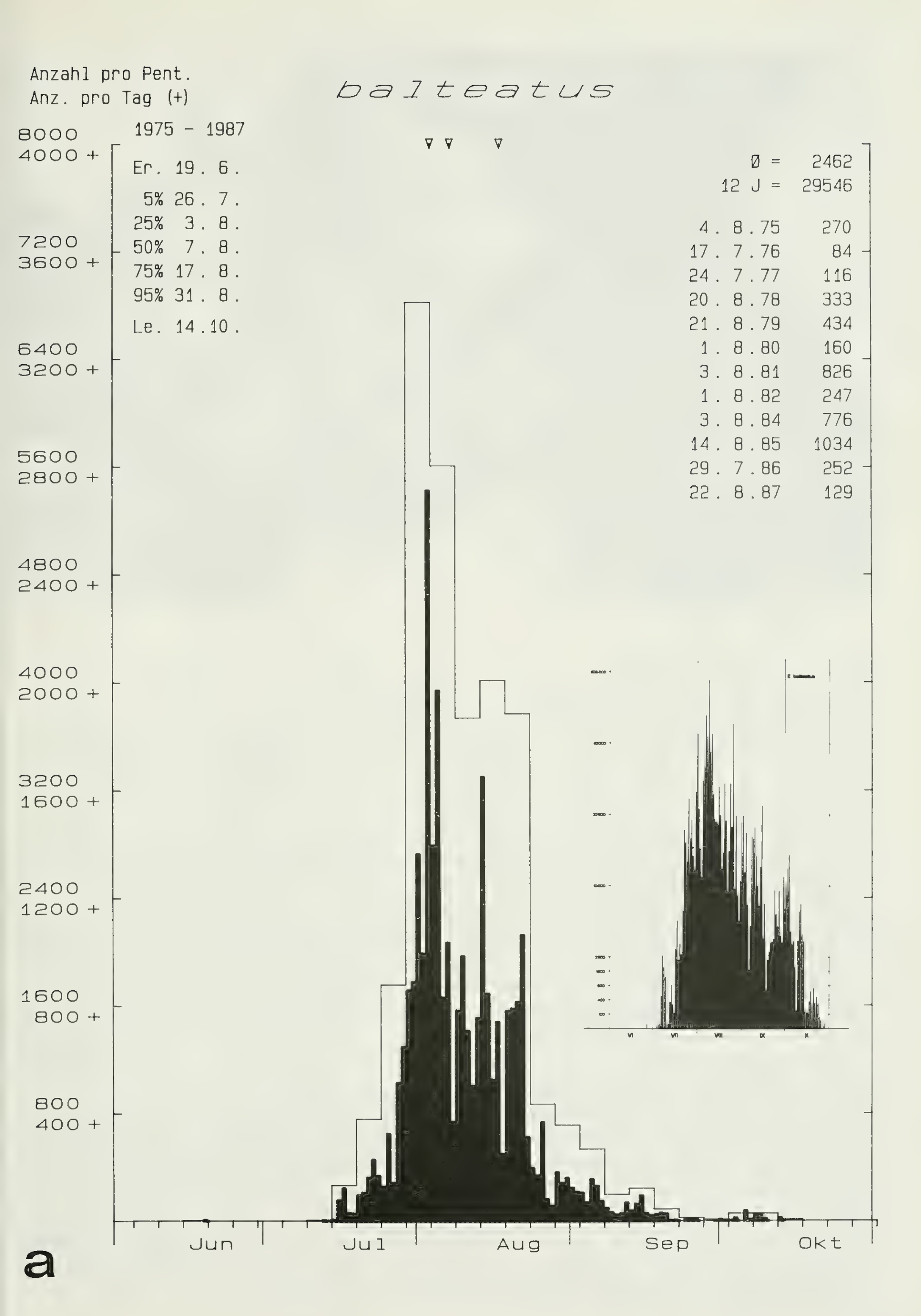
Verbreitung: paläarktisch, orientalisch, australisch

Biologie: Die eurytope Art *E. balteatus* ist eine der häufigsten Schwebfliegen. Sie kann in allen Monaten beobachtet werden. Dušek & Láska (1974) wiesen nach, daß weder Larven noch Puparien den Winter in Zentraleuropa überleben. Nur Imagines können hier überwintern. (Aufenthaltsorte überwinternder ♀♀ sind allerdings bis heute noch nicht gefunden worden.) An den ersten Frühjahrsblühern sind in den Alpen (Goeldlin 1974) wie in den Mittelgebirgen (z. B. Malec 1986, Schmid 1986), im nordwesteuropäischen Flachland (van der Goot 1981) und in England (Stubbs & Falk 1983) regelmäßig auffallend dunkel gefärbte, befruchtete *balteatus*-♀♀ zu sehen. Zum Aufbau der Ovarien ist, wie Schneider (1948) nachwies, Pollenfraß nötig.

Nach den ersten Frühjahrsbeobachtungen folgt häufig eine Zeit, in der man kaum Imagines begegnet. Im Frühsommer ist *balteatus* dann zahlreich. Überaus häufig, oft geradezu massenhaft tritt die Art dann im Hochsommer (ab Juli) bis in den Herbst hinein auf.

Die Larven leben auf den verschiedensten Pflanzen der Baum- und Krautschicht. Sie sind auffällig polyphag (Láska & Starý 1980). Neben ihrer Hauptnahrung, vielen verschiedenen Blattlausarten, ernähren sie sich auch von Käferlarven und Artgenossen (Goeldlin 1974). Die Larven entwickeln sich stets ohne Diapause. So könnten, wenn zwischen einer Eiablage und der nächsten ca. 1½ Monate verstreichen, ungefähr 4–5 Generationen im Jahr gebildet werden, wie Schneider (1948) nach Laborversuchen herausfand. Allerdings werden im Freiland in der Regel nicht so viele Generationen gebildet.

Abb. 15 a: Nach Süden gerichtete Migration von *Episyrphus balteatus* (vgl. Legende zu Abb. 4 a); eingeschaltet ist das Zugmuster am Col de Bretolet (aus Aubert et al. 1976).
Fig. 15 a: Southbound migration of *Episyrphus balteatus;* the insertion shows the phenology at Col de Bretolet.


Anzahl pro Pent.
Anz. pro Tag (+)
balteatus
1975 - 1987
8000
4000 +
7200
3600 +
6400
3200 +
5600
2800 +
4800
2400 +
4000
2000 +
3200
1600 +
2400
1200 +
1600
800 +
800
400 +
Er. 19. 6.
5% 26. 7.
25% 3. 8.
50% 7. 8.
75% 17. 8.
95% 31. 8.
Le. 14.10.
Ø = 2462
12 J = 29546
4. 8.75 270
17. 7.76 84
24. 7.77 116
20. 8.78 333
21. 8.79 434
1. 8.80 160
3. 8.81 826
1. 8.82 247
3. 8.84 776
14. 8.85 1034
29. 7.86 252
22. 8.87 129
Jun
Jul
Aug
Sep
Okt
VI
VII
VIII
IX
X

a



Episyrphus balteatus ♀ (Ph. W. Gatter).

Rotheray (1989) gibt für Großbritannien lediglich eine oder zwei Generationen pro Jahr an, Krüger (1926) für Norddeutschland „mindestens zwei Generationen".

Wanderungen: *Episyrphus balteatus* ist einer der auffälligsten Wanderer unter den Schwebfliegen. Viele Einzelveröffentlichungen über Schwebfliegenwanderungen gehen auf Massenzüge dieser Art zurück. Fast alle diese Beobachtungen betreffen spätsommerliche Bewegungen in südliche Richtungen.

Direkte Beobachtungen von Nordwanderungen sind dagegen äußerst spärlich. Einen Hinweis auf nordgerichtete Bewegungen über einen Alpenpaß Ende Mai verdanken wir L. Verlinden (in litt., 27.6.1989): bei einem Aufenthalt im südtiroler Hochpustertal im Jahr 1985 waren bis zum 22.5. nur dunkel gefärbte ♀♀ zu sehen (s. o.). Am 23.5. (ca. 5 °C, wolkig, nur gelegentlich sonnig, stärkerer NW-Wind) waren in der Nähe des Kreuzbergpasses (Alpe Nemes, 1 850 m NN) erstmals auch ♂♂ zu beobachten, die gemeinsam mit ♀♀ im Windschatten von Weidenbüschen schwebten. Von Zeit zu Zeit, offensichtlich vor allem dann, wenn die Sonne kurzzeitig erschien, flogen kleine Gruppen gegen den Wind, also in nördliche Richtung, ab. Von S her erschienen immer wieder neue Gruppen. Innerhalb kurzer Zeit zogen so mehrere hundert *balteatus* durch. Schlechtes Wetter unterbrach diese Beobachtung wenig später. Das Beobachtungsgebiet liegt im Norden des Talsystems der Piave, das ziemlich direkt nach S ins italienische Alpenvorland geöffnet ist.

An einem 3600 m hohen Himalayapaß in Nepal war im März Nordwanderung von Dipteren zu beobachten. Unter den Belegexemplaren waren auch zwei *balteatus*-♀♀ (Westmacott & Williams 1954). Ebenfalls im Himalaya sah Gatter (1980) Dipteren im Mai über einen 5400 m hohen Paß nach Norden wandern. Auch an diesen Wanderungen hatte *balteatus* teil. Weitere Hinweise auf Nordwanderungen lassen sich aus faunistischen Daten schließen: im nördlichen Europa, wo Überwinterungen der Art nie festgestellt wurden (Torp 1984), liegen die frühesten Beobachtungen am 8.6. in Schleswig (Claußen 1980), am 4.6. in SE-Jütland (Torp 1981) und am 18.6. in S-Norwegen (Nielsen 1971). *Balteatus* wandert also im Laufe des Juni dort ein.

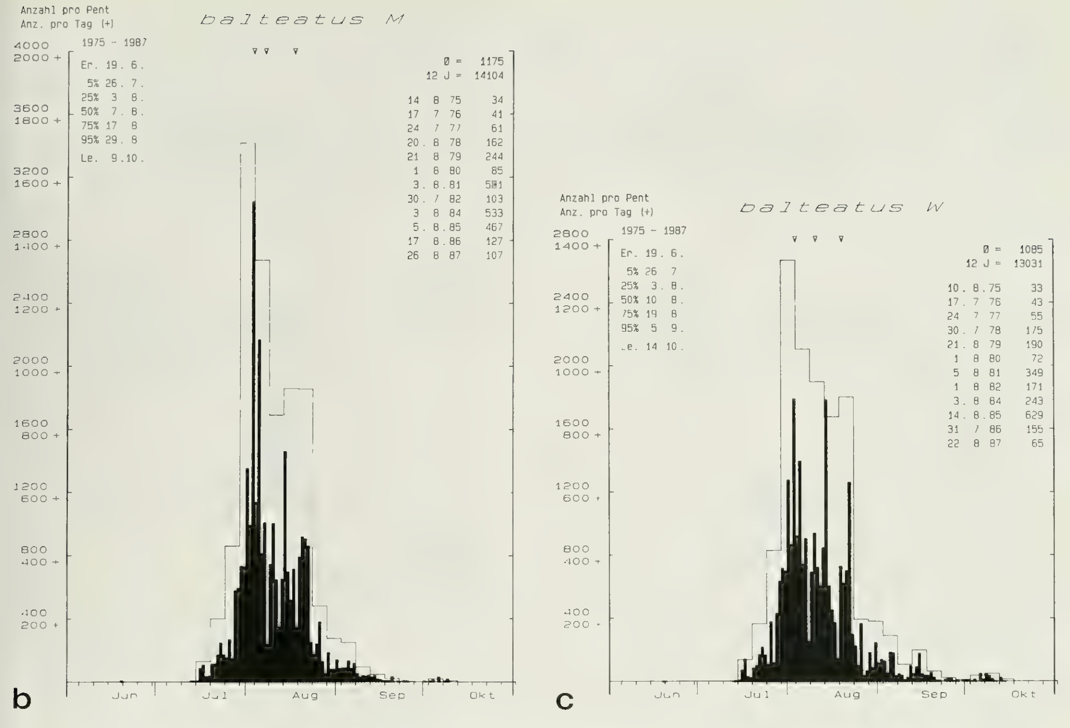


Abb. 15b: Nach Süden gerichtete Migration von *Episyrphus balteatus*-♂♂ (vgl. Legende zu Abb. 4a).
Fig. 15b: Migration of ♂♂ of *Episyrphus balteatus* in southerly direction.

Abb. 15c: Nach Süden gerichtete Migration von *Episyrphus balteatus*-♀♀ (vgl. Legende zu Abb. 4a).
Fig. 15c: Southbound migration of ♀♀ of *Episyrphus balteatus*.

Aber auch die mitteleuropäischen Populationen werden wohl alljährlich in großem Ausmaß von Zuwanderern gestärkt. Verlinden & Decleer (1987) vermuten, daß der Frühsommerbestand in Belgien von ansässigen *balteatus* aufgebaut wird, während die gewaltigen *balteatus*-Massen, die im Hochsommer zu sehen sind, Folge von Einwanderungen aus dem Süden sind. Die Einwanderungen finden dabei allerdings nicht im Hochsommer statt – sämtliche beobachteten Wanderungen in dieser Zeit führen in südliche Richtungen – sondern im Frühjahr. Für das Populationsmaximum sind also nicht die Einwanderer direkt, sondern deren Nachfolgegeneration verantwortlich.

Südwandernde *balteatus* wurden dagegen schon an zahlreichen Plätzen beobachtet. Einige dieser Beobachtungen sollen hier kurz wiedergegeben werden, ohne Vollständigkeit anzustreben.

England:

– In Südengland erreichten zahlreiche *balteatus* gemeinsam mit anderen Arten Anfang August 1928 die Isle of Wight über See aus nordöstlicher Richtung (Flugrichtung also SW) (Mackworth-Praed 1929). Am selben Ort hatte schon Walker (1864) Mitte August große *balteatus*-Schwärme beobachtet. Anfang August 1960 wurde eine aus SE kommende, z. T. von *balteatus* bestrittene Schwebfliegenwanderung in Sussex bemerkt (Spreadbury 1960, Parmenter 1960).

Nördliches Mitteleuropa:

– Feuerschiffe: Von 1388 während drei Wochen im Juli/August 1963 mit Gelbschalen gefangenen Schwebfliegen gehörten 507 (255 ♂♂, 252 ♀♀) zu *balteatus*. Nach *Metasyrphus corollae* war *balteatus* damit die häufigste Art.

Anzahl pro Pent.
Anz. pro Tag (+)

balteatus

1975
Er. 26. 7.
5% 30. 7.
25% 3. 8.
50% 4. 8.
75% 7. 8.
95% 16. 8.
Le. 16. 9.
n = 1276
-49%
4. 8. = 270
3. 8. = 155
5. 8. = 146
30. 7. = 77

1976
Er. 19. 6.
5% 16. 7.
25% 17. 7.
50% 18. 7.
75% 21. 7.
95% 9. 8.
Le. 29. 8.
n = 231
-91%
17. 7. = 84
16. 7. = 47
20. 7. = 20
31. 7. = 15

1978
Er. 16. 7.
25% 2. 8.
50% 15. 8.
75% 20. 8.
95% 15. 9.
n = 3388
+37%
20. 8. = 333
6. 8. = 262
19. 8. = 224

Jun Jul Aug Sep Okt

d1

Anzahl pro Pent
Anz. pro Tag (+)

balteatus

1979
Er. 16. 7.
5% 30. 7
25% 14. 8.
50% 17. 8.
75% 21. 8.
95% 2. 9.
Le. 4.10
n = 2654
+7%
21. 8. = 434
14. 8. = 275
17. 8. = 198
15. 8. = 198

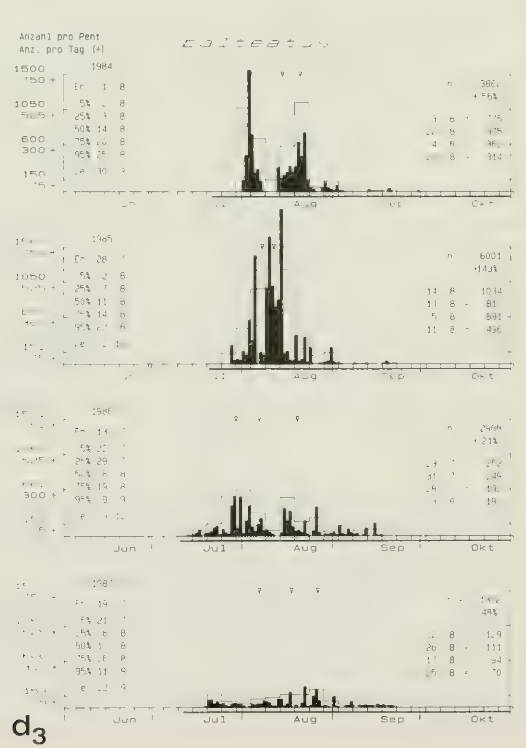
1980
Er. 17. 7.
5% 26. 7.
25% 31. 7.
50% 3. 8.
75% 16. 8.
95% 8. 9.
Le. 19. 9
n = 1323
-47%
1. 8. = 160
3. 8. = 140
4. 8. = 97
26. 7. = 81

1981
n = 4212
+73%
3 8 826
1 8 681

1982
Er. 18. 7.
5% 29. 7.
25% 31. 7.
50% 3. 8.
75% 8. 8.
95% 23. 8.
n = 1587
-36%
1. 8. = 247
30. 7. = 198
4 8 = 167

Jun Jul Aug Sep Okt

d2



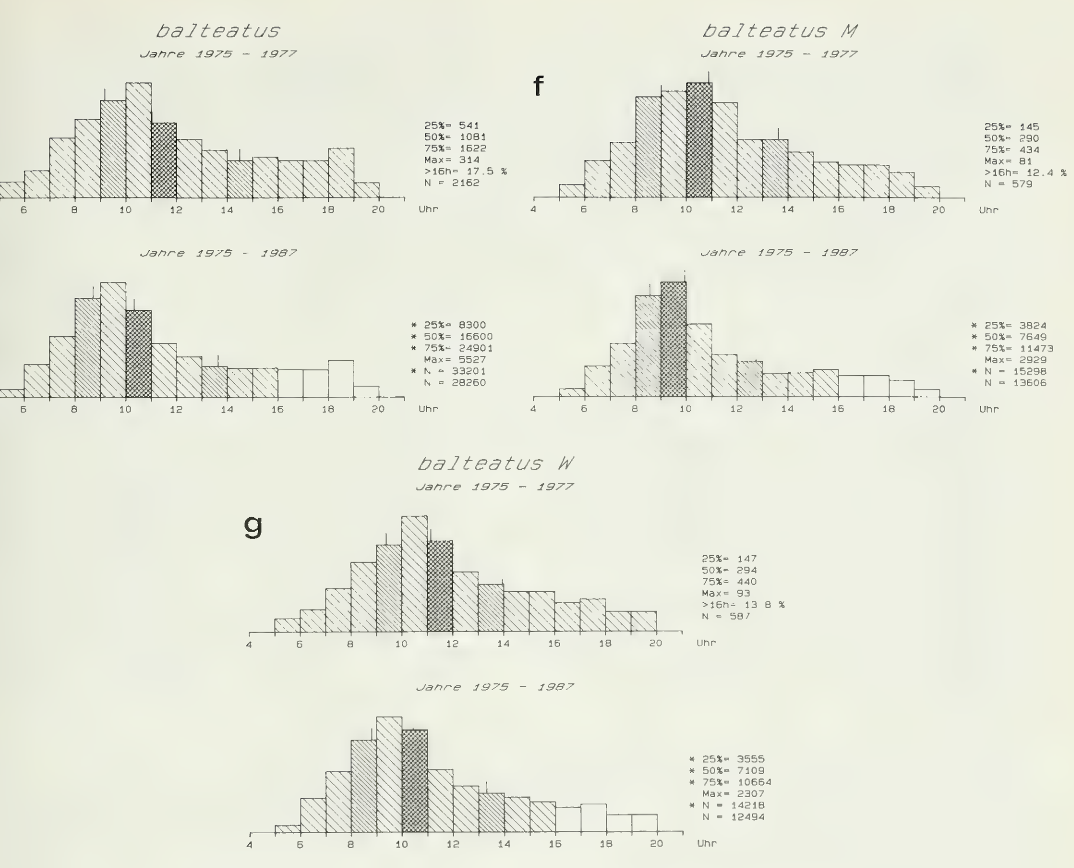


Abb. 15e: Tageszeitliche Verteilung von *Episyrphus balteatus* (vgl. Legende zu Abb. 4d).
Fig. 15e: Diurnal activity patterns of *Episyrphus balteatus* migrating southward.

Abb. 15f: Tageszeitliche Verteilung von *Episyrphus balteatus*-♂♂ (vgl. Legende zu Abb. 4d).
Fig. 15f: Diurnal activity patterns of ♂♂ of *Episyrphus balteatus* migrating southward.

Abb. 15g: Tageszeitliche Verteilung von *Episyrphus balteatus*-♀♀ (vgl. Legende zu Abb. 4d).
Fig. 15g: Diurnal activity patterns of ♀♀ of *Episyrphus balteatus* migrating southward.

504 Expl. wurden dabei auf den zwei in der Ostsee liegenden Feuerschiffen „Kiel" und „Fehmarn-Belt" (Küstenabstand 17–25 km) gefangen, nur 3 Expl. auf dem 30 km vor der Küste liegenden Nordsee-Feuerschiff „Elbe I" (Heydemann 1967). Dieser Unterschied dürfte darauf zurückgehen, daß *balteatus*, von Skandinavien kommend, in sehr großer Zahl über die Ostsee wandert, während die offene Deutsche Bucht gewöhnlich wohl nur selten in großer Zahl überflogen wird.

Auf dem zwischen England und den Niederlanden in ca. 70 km Küstenabstand liegenden Feuerschiff „Noord Hinder" konnte *balteatus* ebenfalls an einigen Tagen vor allem Ende Juli/Anfang August in größerer Anzahl gefangen werden (Lempke 1962).

– Insel Scharhörn: Bei Planbeobachtungen im Jahr 1984 auf der 15 km vor der Küste im inneren Winkel der Deutschen Bucht gelegenen Insel, die keine bodenständige Schwebfliegenfauna aufweist, war *balteatus* zwischen

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Abb. 15d: Nach Süden gerichtete Migration von *Episyrphus balteatus* in den Jahren 1975–1987 (vgl. Legende zu Abb. 5b).
Fig. 15d: Southbound migration of *Episyrphus balteatus* in 1975–1987.

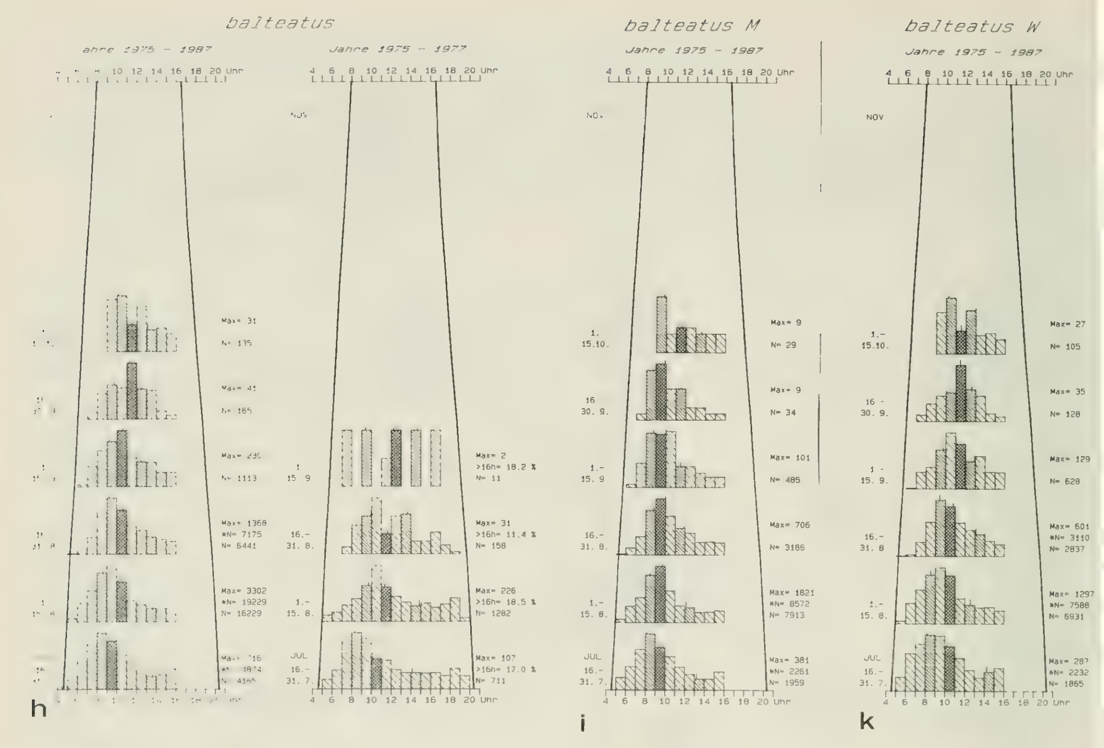


Abb. 15h: Tageszeitliche Verteilung von *Episyrphus balteatus* im Jahresverlauf (vgl. Legende zu Abb. 5h).
Fig. 15h: Diurnal activity patterns of *Episyrphus balteatus* migrating southward throughout the year.

Abb. 15i, 15k: Tageszeitliche Verteilung von *Episyrphus balteatus*-♂♂ (15i, links) und -♀♀ (15k, rechts) im Jahresverlauf (vgl. Legende zu Abb. 5h).
Fig. 15i, 15k: Diurnal activity patterns of ♂♂ (15i) and ♀♀ (15k) of *Episyrphus balteatus* migrating southward throughout the year.

Ende Juli und Ende August an vielen Tagen oft zu Tausenden zu sehen. Gelegentlich konnten auch über dem Watt nach S fliegende Tiere beobachtet werden. Massenwanderungen fanden immer an warmen Tagen mit ablandigen (also aus NE, E, SE oder S wehenden), schwachen oder mäßigen Winden statt (Schmid 1987). Während desselben Jahres auf der Insel Mellum aus Farbschalenfängen gewonnene Daten (Barkemeyer 1988) zeigen dieselben Häufigkeitsmaxima und dokumentieren damit den überregionalen Charakter der auf Scharhörn beobachteten Schwebfliegenwanderungen.

– Nördlicher Mittelgebirgsrand: Auf eine südwestwärts gerichtete Massenwanderung von *E. balteatus* bei Bielefeld vom 7.–10. August weist Eitschberger (1973) hin. Meineke (1979) beobachtete am südwestlichen Rand des Harzes Anfang September starken, ebenfalls nach SW gerichteten Zug.

Alpen:

– Am Col de Bretolet in den Walliser Alpen ist *balteatus* mit Abstand die häufigste Art (Aubert et al. 1976). Sie stellt über die Hälfte aller Fänge (Tab. 2). Der Hauptdurchzugsmonat ist der August; der Zug setzt sich im September aber mit beachtlicher Stärke fort und reicht bis zum Ende der Beobachtungszeit im Oktober (Abb. 15a). Dabei werden fast nur Weibchen gefangen. Eine Stichprobe ergab 93,4 % ♀♀ und nur 6,6 % ♂♂ (15 Fangtage zwischen 7.8. und 27.10., n = 1569; Aubert 1962) (vgl. 4.2).
Von *balteatus* liegen auch einige Fernfunde markierter Individuen vor (Aubert et al. 1969, Aubert & Goeldlin 1981): die maximale Flugstrecke eines Individuums lag dabei bei 111 km (Col de Bretolet bis Col du Glandon). Durch Fang- und Markierungsexperimente an mehreren in südwestlicher Richtung aufeinanderfolgenden Al-

penpässen konnte der Zug von *balteatus* (und anderen Arten) über ca. 160 km verfolgt werden. Dabei wird auch das tief eingeschnittene Rhônetal gequert.

– An mehreren anderen Stellen der schweizer und österreichischen Alpen wurden südgerichtete Schwebfliegenmigrationen beobachtet, bei denen gewöhnlich *Episyrphus balteatus*, im Herbst auch *Eristalis tenax*, die Hauptrolle spielte (z. B. Burmann 1978, Dethier & Goeldlin 1981, Gepp 1975, Harz 1965, Huss 1975, Jeekel & Overbeek 1968, Prell 1925). Häufig gelangen diese Beobachtungen in Pässen. An „starken Zugtagen" werden nach Dethier & Goeldlin (1981) aber auch die höchsten Berggipfel überflogen. Zu auffälligen Massierungen an Pässen kommt es insbesondere bei starkem Föhn; dann wandern die Schwebfliegen in großer Bodennähe gegen den starken Wind und stauen sich an den Pässen (vgl. 3.4). Nach Burmann (1978) und Jeekel & Overbeek (1968) dominieren wie am CB ♀♀ stark. Reusenfänge im schweizer Jura zeigen keine Unterschiede gegenüber den Verhältnissen in den Alpen (Aubert & Jaccard 1981).

Pyrenäen:

Am Paß Port de Gavarnie, auf der französisch-spanischen Grenze in über 2000 m (7500 ft.) gelegen, beobachteten Lack & Lack (1951) am 13.10.1950 eine SW-Wanderung von Schwebfliegen. Die Belegexemplare gehörten zu *Episyrphus balteatus.* Am selben Ort gelang Snow & Ross (1952) am 20.9.1951 folgende Beobachtung: bei Windstille war zwar Schmetterlingswanderung nach SW, aber keine Schwebfliegenmigration festzustellen. Am Nachmittag begann ein allmählich stärker werdender Südwind zu wehen. Gleichzeitig setzte ein ebenfalls stärker werdender Schwebfliegenzug ein. Die Fliegen zogen dabei in großer Bodennähe unterhalb 60 cm (vgl. 3.4). Am folgenden Tag hielten Wind und Schwebfliegenwanderungen an. *Balteatus* gehörte zu den häufigsten Arten. Williams et al. (1956) beobachteten am 9. und 10. Oktober ebenfalls an diesem Paß Schwebfliegenwanderungen, an denen neben *Eristalis tenax* v. a. *Episyrphus balteatus* teilnahm. Auch Grey et al. (1953) sahen in den nördlichen Pyrenäen Ende September/Anfang Oktober Schwebfliegenzug, der überwiegend von den Arten *E. balteatus* und *Eristalis tenax* bestritten wurde.

Phänologie am Randecker Maar: Mit knapp 33 % der Fänge ist *E. balteatus* auch am Maar die häufigste Schwebfliegenart (Tab. 2). Sie wandert hauptsächlich im August (Abb. 15a) mit Schwerpunkt in der ersten Monatshälfte. Der Median liegt in der Hauptzugzeit am 7. August. Der steile Anstieg der Fangzahlen Ende Juli geht z. T. darauf zurück, daß die Station den Betrieb in einigen Jahren erst in der letzten Julidekade aufnahm. Das schnelle Abflauen des Fanges Ende August liegt jedoch voll in der Beobachtungsperiode. Im September und Oktober erscheint *balteatus* mit 5 % der Gesamtsummen nur noch spärlich.

Beide Geschlechter sind am Maar ungefähr gleich stark vertreten (♂♂ : ♀♀ = 1:0,92; n = 27135). Die ♂♂ sind etwas stärker auf den Beginn der Zugzeit konzentriert (Abb. 15b, 15c).

Die Fangergebnisse weisen von Jahr zu Jahr starke Schwankungen auf (Abb. 27l). Trotz dieser hohen Variabilität lassen die jährlichen Durchzugsdiagramme (Abb. 15d) das Grundmuster der zusammengefaßten Daten (Abb. 15a) fast immer erkennen. Nur in seltenen Fällen liegt der Medianwert außerhalb der ersten Augusthälfte.

Das tageszeitliche Muster zeigt einen für *balteatus* typischen, ausgeprägten Vormittagsgipfel mit einem Aktivitätsmaximum zwischen 8 und 11 Uhr (Abb. 15e). Bei ♂♂ ist diese einseitige Verteilung sogar noch etwas extremer als bei ♀♀ (Abb. 15f, 15g). Die Form der Aktivitätskurve bleibt im Jahresverlauf im wesentlichen erhalten (Abb. 15h). Nur der Medianwert, der im Juli noch vor zehn Uhr liegt, verschiebt sich bis Mitte September in das Zeitintervall 10–11 Uhr und bis Mitte Oktober in das Intervall 11–12 Uhr. Auch aus diesen Darstellungen wird ersichtlich, daß der Aktivitätsgipfel der ♂♂ stets deutlich vor dem der ♀♀ liegt (Abb. 15i, 15k).

Mit Hilfe von Gelbschalenfängen ermittelte Grosser (1979) für *balteatus* ein sehr deutliches Aktivitätsmaximum in den ersten zwei Stunden nach Sonnenaufgang (5–7 Uhr). In dieser Zeit widmet sich *balteatus* also hauptsächlich der Nahrungsaufnahme. Erst nach dieser frühmorgendlichen Phase des Nahrungserwerbs setzt die Migration ein.

In der N-Reuse wird *balteatus* nur sehr spärlich gefangen (Abb. 27l): S-Reuse : N-Reuse = 7,4:1 (n = 8902). Es dürfte sich dabei um Tiere handeln, die in der Umgebung Nahrungsflüge unternehmen.

In die S-Reuse geraten die Fliegen vor allem bei Gegenwind, fast nie bei Rückenwind (Abb. 26d; vgl. 3.4): 79 % werden bei Winden aus SW, S oder SE gefangen, nur 0,6 % bei Winden aus NW, N oder NE.

Status: Saisonaler Migrant.

Im südwestdeutschen Mittelgebirge zeigen die sehr starken quantitativen Schwankungen der im Frühjahr beobachteten ♀♀ (Schmid 1986 und i. Dr.), daß die Überwinterung hier mit großem klimatischem Risiko behaftet ist. In den Alpen dürften die Verhältnisse nicht wesentlich anders sein. Erst im südlichen (mediterranen) Europa oder Nordafrika sind Bedingungen zu erwarten, die eine ungefährdetere Überwinterung gestatten. Hierhin dürften die spätsommerlichen Wanderungen von *balteatus* führen. Allerdings sind die Lebensverhältnisse im Mittelmeergebiet im Sommer eher ungünstig. Die dann weitgehend vertrocknete Krautflora steht als Blattlausnahrung nicht zur Verfügung. Die relativ wenigen Blüten der sommerlichen Mittelmeerflora sind für die meist kurzrüsseligen Schwebfliegen überdies oft nicht leicht zugänglich. Wesentlich günstigere Verhältnisse findet *balteatus* im Sommer dagegen im humiden Mitteleuropa, wo für Larven ein großes Blattlaus- und für Imagines ein reichhaltiges Blütenangebot zur Verfügung steht. Im Frühjahr wandert die Art deshalb nach Mitteleuropa ein.

Das hier skizzierte Bild des biologischen Hintergrundes der saisonalen Wanderungen von *balteatus* ist aus wenigen Mosaiksteinen zusammengesetzt und hat deshalb noch weitgehend hypothetischen Charakter.

Zur Überprüfung der Hypothese sind selbst auf den ersten Blick wenig aussagekräftige Beobachtungen wertvoll. So sah z. B. Gatter (unveröff.) im August in Tälern der nördlichen Appenninen und der Pyrenäen auf ca. 1 000 – 1 800 m NN praktisch keine Syrphiden der bekannten und häufigen Wanderarten. Sie hatten diese von „einheimischen Populationen" im Sommer freien Gebiete auf ihrer herbstlichen Südwanderung vermutlich noch nicht erreicht.

Sphaerophoria scripta (Linnaeus 1758)

Verbreitung: paläarktisch, orientalisch (Nordindien, Nepal)

Biologie: *S. scripta* ist eine sehr häufige und eurytope Art, die zwischen (Mitte März) Mitte April und Mitte (Ende) Oktober beobachtet wird. Sie bildet in dieser Zeit mehrere Generationen (in Mitteldeutschland nach Grosser & Klapperstück [1976] drei Generationen). Am zahlreichsten kommt die Art im Hoch- und Spätsommer vor. In Belgien entspricht die Häufigkeitskurve von *scripta* weitgehend der von *Episyrphus balteatus* mit mäßig hohen Zahlen im Frühsommer und einem Maximum, das Mitte Juli sehr abrupt beginnt und Anfang September fast ebenso abrupt endet (Verlinden & Decleer 1987).

Scripta-Larven leben überwiegend in der Krautschicht, wo sie sich von Blattläusen ernähren (Bańkowska 1964). Nach Dušek & Láska (1974) überwintert *scripta* als Larve. Beweise für die von Bańkowska (1964) vermutete Überwinterung weiblicher Imagines fehlen.

Wanderungen: Nordgerichtete Frühjahrswanderungen von Dipteren, an denen auch *S. scripta* teilnahm, beobachtete Gatter (1980) an einem in 5 400 m Höhe gelegenen Himalayapaß im Mai. Im Sommer und Herbst ist *scripta* ein auffälliger und zahlreicher Süd-Wanderer. Aus den Alpen liegen u. a. Beobachtungen von Aubert et al. (1976), Gepp (1975) und Jeekel & Overbeek (1968) vor. Das Phänologie-Diagramm bei Aubert et al. zeigt, nach steilem Anstieg ab Mitte Juli, einen ausgeprägten Gipfel in der ersten Augusthälfte und ein rasches Abnehmen der Fangzahlen in der zweiten Augusthälfte. Zwei am Krinnenpaß in der Schweiz markierte Individuen wurden am ca. 50 km südwestlich liegenden Col de Bretolet wiedergefangen (Aubert & Goeldlin 1981).

In Norddeutschland wurden nicht bodenständige Tiere dieser Art in einigen Exemplaren auf Feuerschiffen (Heydemann 1967, Lempke 1962) und in großer Zahl im Juli und August auf der Insel

Spaerophoria scripta ♂ (Ph. W. Gatter).

Sphaerophoria scripta ♀ (Ph. W. Gatter).

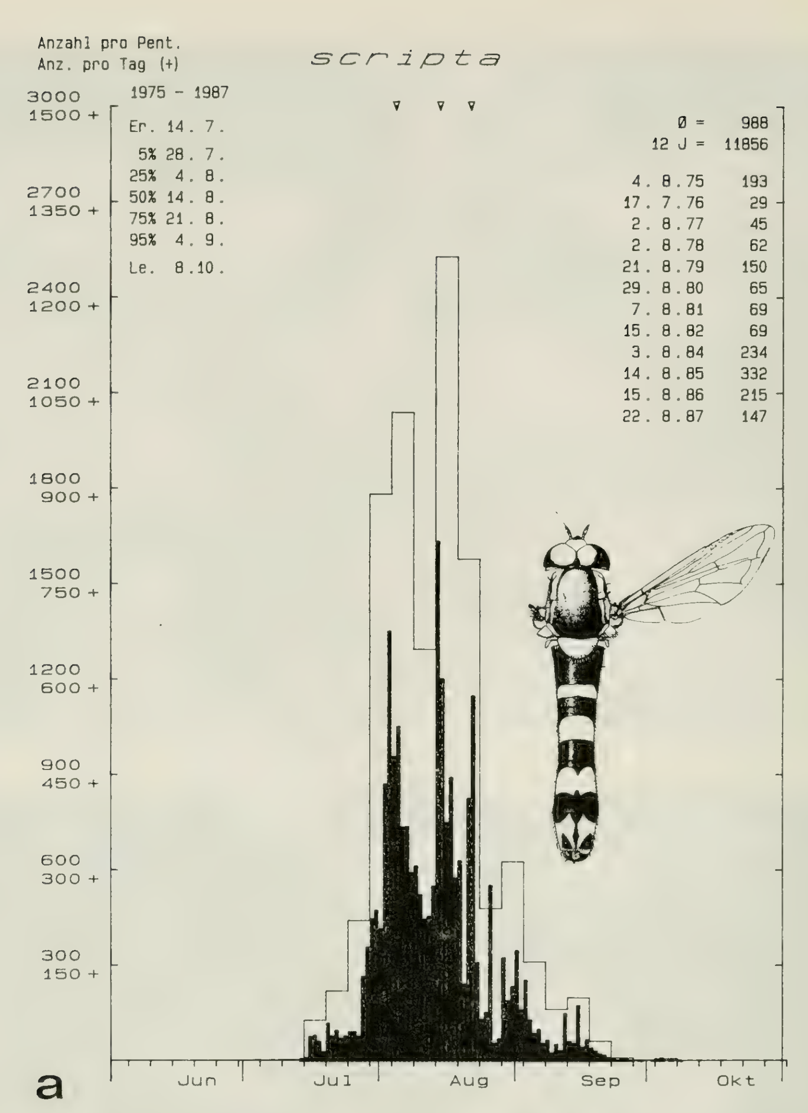


Abb. 16a: Nach Süden gerichtete Migration von *Sphaerophoria scripta* (vgl. Legende zu Abb. 4a) (eingefügte Zeichnung aus van der Goot 1981).
Fig. 16a: Southbound migration of *Sphaerophoria scripta.*

Scharhörn (Schmid 1987) gefunden. Hinweise auf Wanderungen in S-England liegen ebenfalls vor (Parmenter 1960).

Phänologie am Randecker Maar: *S. scripta* ist wie am Col de Bretolet eine der häufigsten Arten (Tab. 2). Sie wird auch am RM hauptsächlich im August gefangen (Abb. 16a). Im September erscheinen nur noch wenige Individuen. ♀♀ treten am Maar fast doppelt so häufig auf wie ♂♂ (♂♂ : ♀♀ = 1:1,7; n = 11204). Im jahreszeitlichen Muster ihres Vorkommens besteht kein Unterschied (Abb. 16b, 16c).

Auch das tageszeitliche Aktivitätsmuster der beiden Geschlechter ähnelt sich stark. Insgesamt ist die Verteilung nahezu symmetrisch mit einem Maximum in der Mittagszeit (Abb. 16d).

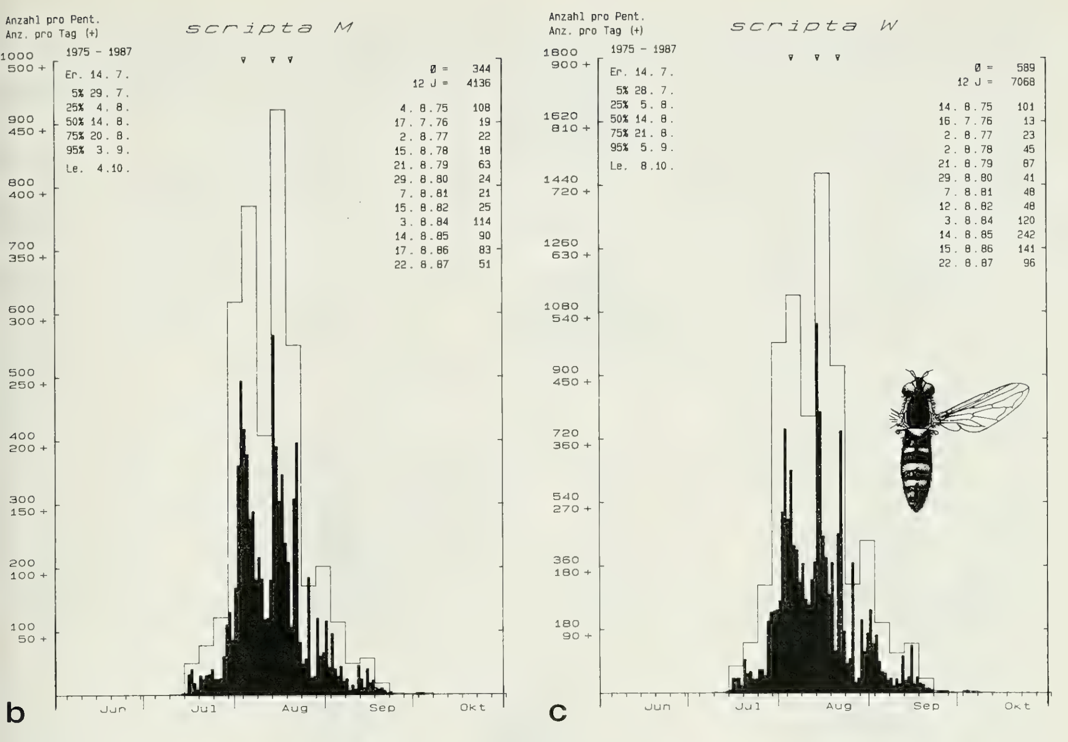


Abb. 16b: Nach Süden gerichtete Migration von *Sphaerophoria scripta*-♂♂ (vgl. Legende zu Abb. 4a).
Fig. 16b: Southbound migration of ♂♂ of *Sphaerophoria scripta.*

Abb. 16c: Nach Süden gerichtete Migration von *Sphaerophoria scripta*-♀♀ (vgl. Legende zu Abb. 4a) (eingefügte Zeichnung aus van der Goot 1981).
Fig. 16c: Southbound migration of ♀♀ of *Sphaerophoria scripta.*

Das Verhältnis zwischen S-Reuse und N-Reuse liegt bei 3,5:1 (n = 2696). Eine Auswertung der Windrichtungen an den Hauptflugtagen zeigt, daß *scripta* überwiegend bei Gegenwind aus SW, S und SE (66,9%) und nur selten bei Rückenwind aus NW, N und NE (17,7%) in die S-Reuse fliegt (Abb. 27m).

Status: Saisonaler Migrant.

„*Sphaerophoria menthastri*-Gruppe"

Unter diesem Namen werden mehrere Arten zusammengefaßt, die zu Beginn der Untersuchungen mit den Bestimmungsschlüsseln von Sack (1932) nicht unterschieden werden konnten. Auch heute sind oft nur die ♂♂ dieser Artengruppe genau bestimmbar. Überwiegend werden aber Weibchen gefangen. Die in der ersten Hälfte unseres Jahrhunderts sämtlich als *Sphaerophoria menthastri* (Linnaeus 1758) bezeichneten Tiere dieser Gruppe erweisen sich als zahlreichen verschiedenen Arten zugehörig. Erst jüngst beschrieb Goeldlin (1989) vier neue Arten aus der westlichen Paläarktis.

Die vorliegenden Belegexemplare lassen vermuten, daß *S. menthastri* (Linnaeus 1758) – nach Goeldlin (1989) ist der gültige Name *S. interrupta* (Fabricius 1805) – am Randecker Maar die häufigste Art der Gruppe ist. Außerdem wurden *S. fatarum* Goeldlin 1989 – in Schmid & Gatter (1988) unter dem Namen *abbreviata* Zetterstedt 1859 aufgeführt – und *S. taeniata* (Meigen 1822) nachgewiesen. Insgesamt sind Fliegen dieser Gruppe aber eher selten. Sie werden hauptsächlich im August ge-

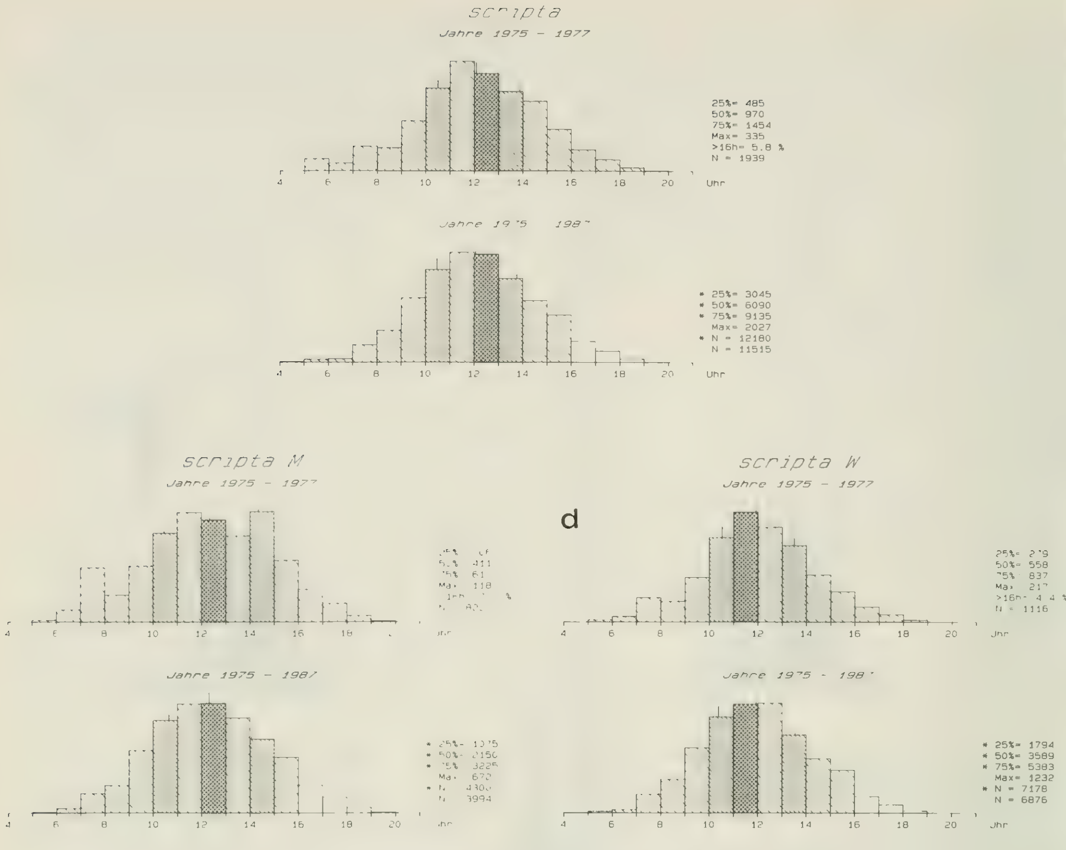


Abb. 16d: Tageszeitliche Verteilung von *Sphaerophoria scripta* (vgl. Legende zu Abb. 4d).
Fig. 16d: Diurnal activity patterns of *Sphaerophoria scripta* migrating southward.

fangen. Ihre geringe Zahl läßt keinen Schluß auf mögliches Wanderverhalten zu. Auch von anderen Gebieten fehlen Hinweise auf zahlenstärkere Wanderungen weitgehend. Goeldlin (1989) weist darauf hin, daß die in Speziation befindliche „*menthastri*-Gruppe" auch intraspezifisch sehr variabel ist, während die wandernde Art *Sphaerophoria scripta* im gesamten riesigen Verbreitungsgebiet bemerkenswert wenig variabel ist – ein weiterer Hinweis auf die sehr geringe Mobilität der „*menthastri*-Gruppe" (vgl. auch 4.5).

3.1.2 Schwebfliegen mit terrestrischen saprophagen Larven

Rhingia campestris Meigen 1822

Verbreitung: paläarktisch

Biologie: Die Larven von *Rhingia campestris* entwickeln sich in Kuhdung (Krüger 1926, Coe 1942). Die Imagines sind zwischen (Mitte März) Mitte April und Mitte Oktober (Anfang November) zu sehen. Sie fliegen in zwei deutlich ausgeprägten Generationen vor allem im Frühling und im Spätsommer. Vermutlich überwintern diapausierende Larven (Coe 1942).

Wanderungen: Hinweise auf Wanderungen von *R. campestris* existieren nicht. Die am Col de Bretolet hauptsächlich zwischen Anfang August und Mitte September gefangenen Tiere (Tab. 2) entstammen wohl ansässigen Populationen (Aubert et al. 1976).

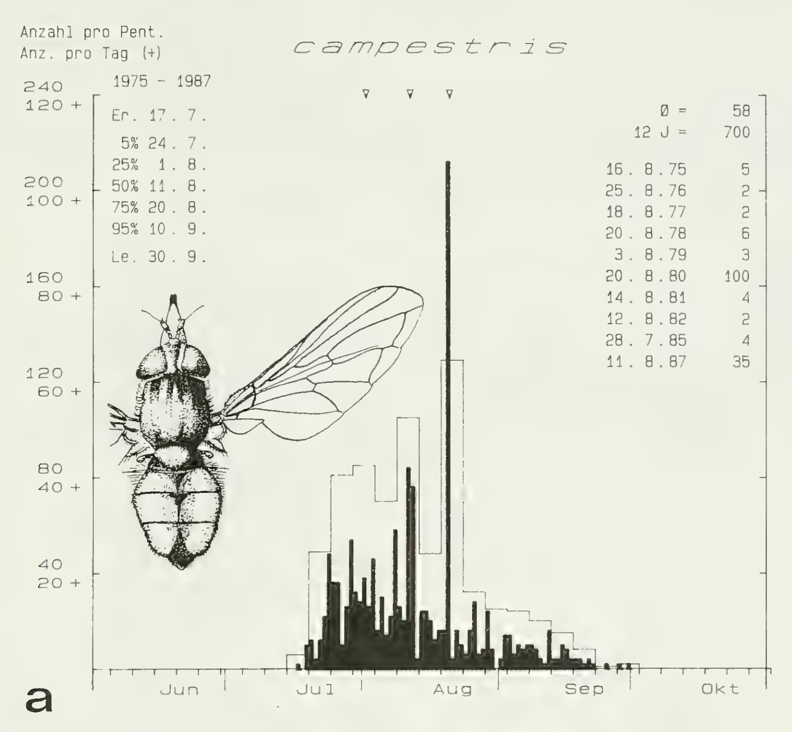


Abb. 17a: Fänge in der S-Reuse von *Rhingia campestris* (vgl. Legende zu Abb. 4a) (eingefügte Zeichnung aus van der Goot 1981).
Fig. 17a: Trapped individuals with northerly opening trap (S-trap) of *Rhingia campestris.*

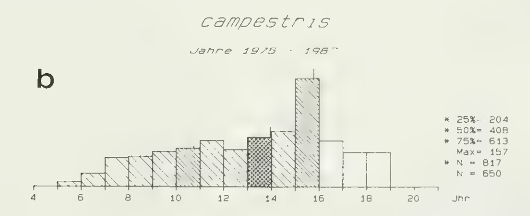


Abb. 17b: Tageszeitliche Verteilung von *Rhingia campestris* (vgl. Legende zu Abb. 4d).
Fig. 17b: Diurnal activity patterns of *Rhingia campestris.*

Phänologie am Randecker Maar: Auch im Bereich der kleinen, gebüschbestandenen Kuppe, auf der die Station Randecker Maar liegt, lebt eine Population von *campestris,* von deren Sommergeneration sich regelmäßig einige Fliegen in den Reusen fangen (Tab. 2 und Abb. 17a). Da die ♂♂ oft stundenlang schwebend an Gebüschrändern und über der Reuse in der Luft stehen, während die ♀♀ auf Blüten der Krautschicht Nahrung suchen, sind ♂♂ in den Reusenfängen leicht überrepräsentiert (♂♂ : ♀♀ = 1:0,8; n = 367).

Abb. 17b zeigt im Tagesverlauf bis zum frühen Nachmittag eine weitgehend ausgeglichene Verteilung. Das Flugaktivitätsmaximum liegt am späteren Nachmittag. Es unterscheidet sich damit grundsätzlich vom Aktivitätsmuster der Wanderarten mit ihrem Aktivitätsmaximum am späten Vormittag oder um die Mittagszeit (Gatter 1981b).

Das starke Ungleichgewicht zwischen den beiden Reusen (S-Reuse : N-Reuse = 5,3:1; n = 498) läßt sich dadurch erklären, daß die S-Reuse auf der Kuppe in einer Schneise zwischen Büschen steht – dort schweben die *campestris*-♂♂ bevorzugt und dort sind in der Krautschicht auch im Spätsommer zahlreiche Blüten zu finden, an denen die nahrungssuchenden ♀♀ zu sehen sind – während sich die N-Reuse direkt auf eine offene, im Spätsommer nahezu blütenlose Wirtschaftswiese öffnet.

Status: Bivoltine Art ohne Migrationsneigung.

Neoascia podagrica (Fabricius 1775)

Verbreitung: paläarktisch

Biologie: Diese kleine Schwebfliege besiedelt viele Lebensräume und ist sehr häufig. Ihre Larven leben saprophag von pflanzlichen und tierischen Abfällen. Die Flugzeit beginnt (Ende März) Mitte April und endet Mitte Oktober. Nach Hartley (1961) überwintern die Larven. Nielsen (1972) vermutet allerdings, daß Aprilbeobachtungen in S-Norwegen auf überwinternde Imagines zurückgehen.

Wanderungen: Der einzige Hinweis auf nicht bodenständige Individuen liegt von der Nordseeinsel Scharhörn vor, wo an einem Tag 7 Tiere gefangen wurden (Schmid 1987).

Phänologie am Randecker Maar: Diese häufige Art wird regelmäßig, wenn auch nicht sehr zahlreich, in den Reusen gefangen (Tab. 2, Abb. 18). Vermutlich werden die sehr zarten Fliegen vom Wind dorthin verdriftet. Dabei geraten wesentlich mehr Fliegen in die S-Reuse (S-Reuse : N-Reuse = 4,6:1; n = 124). Der Grund dürfte derselbe sein wie bei *Rhingia campestris: N. podagrica* lebt über-

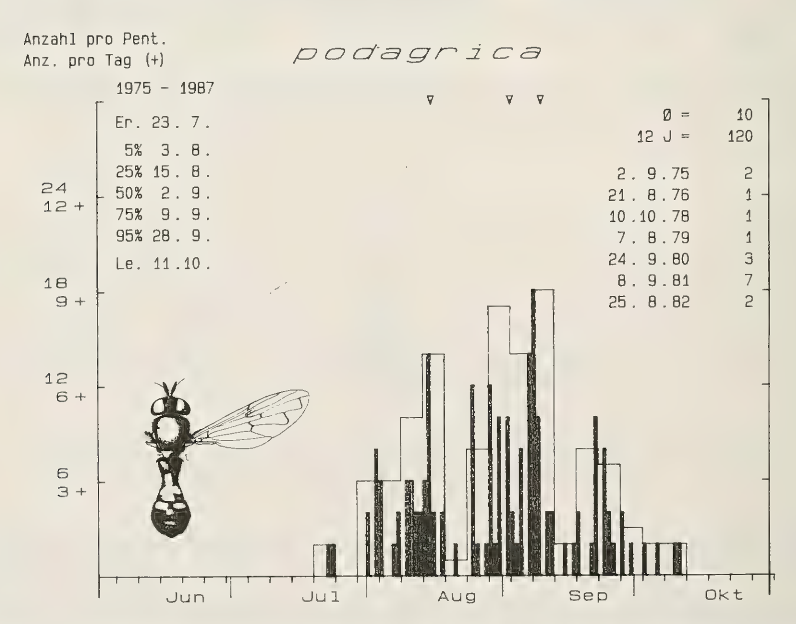


Abb. 18: Fänge in der S-Reuse von *Neoascia podagrica* (vgl. Legende zu Abb. 4a) (eingefügte Zeichnung aus van der Goot 1981).
Fig. 18: Trapped individuals with northerly opening trap (S-trap) of *Neoascia podagrica.*

wiegend im Bereich der einschürigen Wiese der Gebüschkuppe und wird deshalb überwiegend in der S-Reuse gefangen.

Status: Polyvoltine Art mit geringer saisonaler Dismigrationsneigung.

Syritta pipiens (Linnaeus 1758)

Vorkommen: holarktisch, orientalisch (Nepal)

Biologie: *S. pipiens* gehört zu den häufigsten Schwebfliegenarten. Sie ist zwischen (Ende März) Mitte April und Mitte Oktober (Anfang November) in nahezu allen Lebensräumen zu beobachten. Am häufigsten ist die Art im Hochsommer. Die Larven ernähren sich von pflanzlichen und tierischen Abfällen wie Kompost, Dung usw. (Hartley 1961, Krüger 1926). Die Larven überwintern (Hartley 1961).

Wanderungen: Die einzigen Hinweise auf Wanderungen sind einige Funde (6 Expl.) auf Feuerschiffen (Heydemann 1967) und Beobachtungen (18 Expl.) auf der Nordseeinsel Scharhörn (Schmid 1987). Aus den Alpen fehlen Wanderbeobachtungen (vgl. Tab. 2).

Phänologie am Randecker Maar: Von dieser Art werden – verglichen mit ihrer Häufigkeit – nur sehr wenige Tiere in den Reusen gefangen (Tab. 2). Sie entstammen mit großer Wahrscheinlichkeit der ansässigen Population. In der Umgebung der Station, vor allem im 200 m südlich gelegenen Schopflocher Moor, ist die Art oft extrem häufig.

Status: Polyvoltine Art mit sehr geringer saisonaler Dismigrationsneigung.

3.1.3 Schwebfliegen mit aquatischen sapro-/microphagen Larven

Eristalis arbustorum (Linnaeus 1758)

Verbreitung: paläarktisch, orientalisch (Nordindien); nearktisch verschleppt

Biologie: Die eurytopen Imagines der häufigen *E. arbustorum* können zwischen (Anfang März) Mitte April und Ende Oktober beobachtet werden, dürften also in mehreren Generationen auftreten. Im Spätsommer ist die Art am häufigsten. Ansonsten können meist keine weiteren deutlichen Maxima beobachtet werden. Die Larven werden gewöhnlich in stark eutrophierten Gewässern (Hartley 1961), aber auch in Haufen faulender Pflanzen (Krüger 1926) gefunden. Die Larve überwintert (Hartley 1961, Krüger 1926).

Wanderungen: Am Col de Bretolet wird die Art, obwohl nicht allzu zahlreich gefangen (Tab. 2), als Wanderer eingestuft (Aubert et al. 1976). Sie kommt dort fast während der ganzen Fangperiode

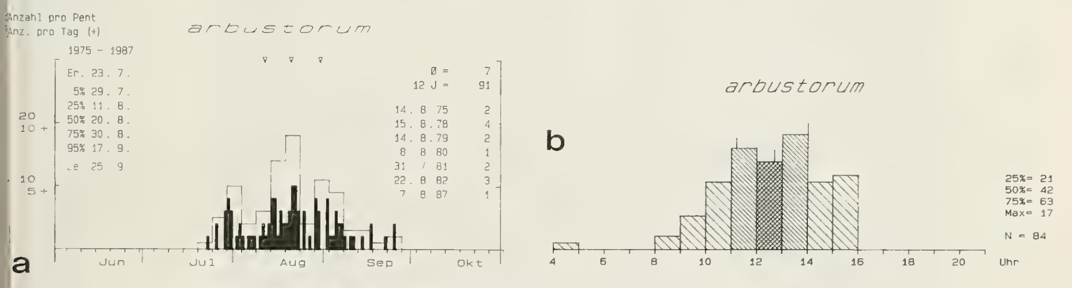


Abb. 19a: Nach Süden gerichtete Migration von *Eristalis arbustorum* (vgl. Legende zu Abb. 4a).
Fig. 19a: Southbound migration of *Eristalis arbustorum.*

Abb. 19b: Tageszeitliche Verteilung von *Eristalis arbustorum* (vgl. Legende zu Abb. 4d).
Fig. 19b: Diurnal activity patterns of *Eristalis arbustorum* migrating southward.

ohne ausgesprochene Maxima vor. Bei einer in Tirol beobachteten Schwebfliegenwanderung war *arbustorum* ebenfalls unter den gesammelten Belegexemplaren (Jeekel & Overbeek 1968).

Aus Norddeutschland liegen einige Funde von Feuerschiffen (Heydemann 1967) und Beobachtungen auf der Nordseeinsel Scharhörn vor (Schmid 1987). Dort erscheint die Art zwar regelmäßig, aber, gemessen an ihrer Häufigkeit, in nur geringer Zahl.

Phänologie am Randecker Maar: Auch hier wird *arbustorum* nur in geringer Zahl hauptsächlich im August in den Reusen gefangen (Tab. 2, Abb. 19a). Das tageszeitliche Aktivitätsmuster zeigt Abb. 19b. Obwohl das Material sehr gering ist, ist der Unterschied zwischen den beiden Reusen deutlich (S-Reuse: N-Reuse = 5:1; n = 30.

Status: Saisonaler Migrant mit geringer Migrationsneigung.

Verglichen mit der Häufigkeit von *arbustorum* ist die Zahl der Wanderer klein. Für die alljährliche Populationsentwicklung in Mitteleuropa dürften Migranten keine wesentliche Bedeutung haben.

Eristalis interrupta (Poda 1761) (= E. nemorum auct.)

Verbreitung: holarktisch

Biologie: Die Entwicklung dieser Art dürfte weitgehend der von *arbustorum* gleichen (Hartley 1961). Auch *E. interrupta* ist eine eurytope, allerdings offene Habitate eher meidende, und häufige Art; sie kann von (Mitte April) Anfang Mai bis Anfang (Mitte) Oktober gesehen werden. Ihre größte Häufigkeit erreicht sie im Hochsommer.

Wanderungen: Von *interrupta* liegen keine auf Wanderungen hinweisende Beobachtungen vor.

Phänologie am Randecker Maar: Die Art wird – verglichen mit ihrer Häufigkeit – nur selten gefangen (Tab. 2). Es dürfte sich dabei um Tiere der näheren Umgebung handeln.

Status: Der Status dieser Art entspricht möglicherweise dem von *E. arbustorum*. Die Wanderneigung von *interrupta* ist allerdings äußerst gering.

Eristalis pertinax (Scopoli 1763)

Verbreitung: westpaläarktisch

Biologie: Die sehr häufige, eurytope *pertinax* kann von (Ende Februar) Mitte April bis Ende Oktober (Anfang November) beobachtet werden. Sie ist schon im Mai sehr zahlreich anzutreffen und ist im Sommer oft eine der häufigsten Schwebfliegenarten. Die Larven leben in eutrophen Gewässern. Die Art überwintert im Larvenstadium (Hartley 1961).

Wanderungen: Am Col de Bretolet trat die Art kaum in Erscheinung (Aubert et al. 1976; Tab. 2). Die wenigen Fänge konzentrieren sich auf den August. Dethier & Goeldlin (1981) bezeichnen *pertinax* als Wanderart. Aus Norddeutschland liegt ein Fund von einem Feuerschiff vor (Heydemann 1967). Auf der Nordseeinsel Scharhörn konnte *pertinax* zwar nicht häufig, aber doch regelmäßig nachgewiesen werden. Von hier stammen auch Beobachtungen nach SW fliegender Tiere (Schmid 1987).

Phänologie am Randecker Maar: Verglichen mit der Häufigkeit der Art wird *pertinax* in den Reusen sehr selten gefangen (Tab. 2). Allerdings sagt das wenig über den tatsächlichen „Flugverkehr" aus. Für *pertinax* könnte hier dasselbe gelten wie für *tenax*: die meisten Fliegen erkennen die Reusen als Hindernis und um- oder überfliegen sie gezielt. Einen Hinweis auf gerichtete Wanderungen von *pertinax* geben die Zahlenverhältnisse zwischen den Reusen: auf 34 in der S-Reuse gefangene Ex. kam nur 1 Ex. aus der N-Reuse.

Status: Saisonaler Migrant mit geringer Wanderneigung (vgl. *E. arbustorum*).

Eristalis tenax (Linnaeus 1758)

Verbreitung: kosmopolitisch

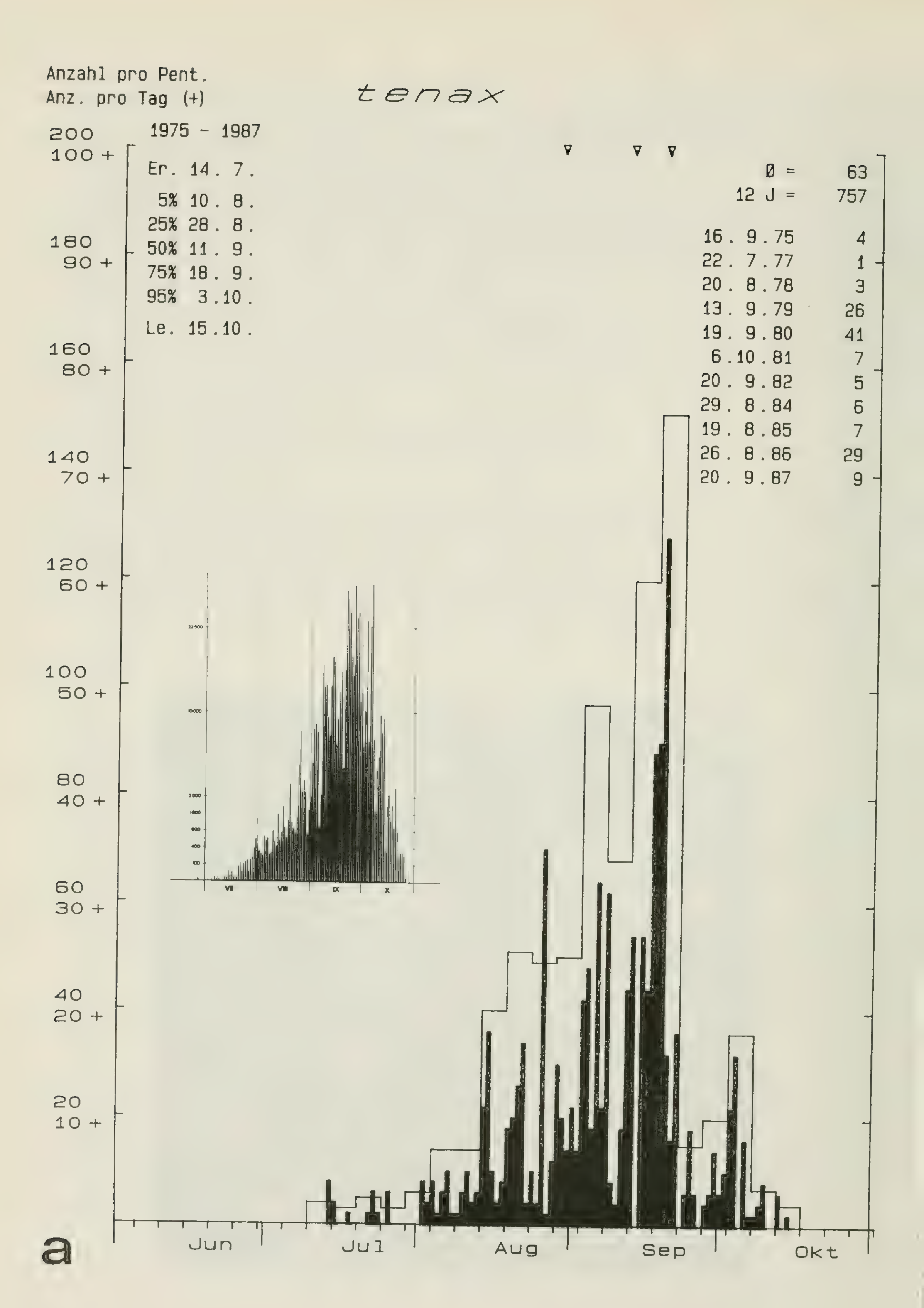
Biologie: ♀♀ von *E. tenax* überwintern selbst im nördlichen Europa noch regelmäßig (z. B. Torp 1984, Nielsen 1972). Sie sind im frühesten Frühjahr schon auf Blüten zu sehen. Im späten Frühjahr ist *tenax* ausgesprochen selten. Erst im Frühsommer wird die Art wieder regelmäßig angetroffen. Im Hoch- und vor allem im Spätsommer und Herbst ist *tenax* eine der häufigsten Schwebfliegenarten. Sie kann bis in den November hinein gesehen werden. Ihre Rattenschwanz-Larven leben in eutrophen Gewässern. Selbst Extremhabitate werden besiedelt (Jauche, sich zersetzendes Aas etc.).

Wanderungen: *Eristalis tenax* gehört zu den auffälligsten Wanderern unter den Schwebfliegen. Gatter (1980) beobachtete im Frühjahr (Mai) nordwärts gerichteten Schwebfliegenzug über einen 5400 m hohen Himalaya-Paß. Unter den Belegexemplaren waren auch 3 *Eristalis tenax*. Beobachtungen herbstlicher SW-Wanderungen liegen aus den Pyrenäen (Snow & Ross 1952, Williams et al. 1956), den Alpen (z. B. Aubert et al. 1976, Eimer 1880, Prell 1925), den südwestdeutschen Mittelgebirgen (Gatter 1975a, 1976, Gatter & Gatter 1973) und aus dem mitteleuropäischen Küstenbereich vor (Lempke 1962, Schmid 1987). Williams (1961: 102) erwähnt regelmäßige Herbstwanderungen von *Eristalis* entlang der Küste von New Jersey/USA in südliche Richtung. Möglicherweise handelt es sich auch hier um *E. tenax*.

Eristalis tenax ist, vor allem wenn es sich um Beobachtungen im Frühherbst handelt, oft die häufigste und auffälligste Wanderart. Am Col de Bretolet ist *tenax* nach *Episyrphus balteatus* die am häufigsten gefangene Art (Tab. 2, Abb. 20a). Die Durchzugszahlen steigern sich von geringen Tagessummen im Juli bis zum sehr ausgeprägten Maximum im September und der ersten Oktoberdekade. Bis Ende Oktober nehmen die Zahlen wieder sehr stark ab.



Eristalis tenax ♂ (Ph. W. Gatter).


Anzahl pro Pent.
Anz. pro Tag (+)
tenax
1975 - 1987
200
100 +
180
90 +
160
80 +
140
70 +
120
60 +
100
50 +
80
40 +
60
30 +
40
20 +
20
10 +
Er. 14. 7.
5% 10. 8.
25% 28. 8.
50% 11. 9.
75% 18. 9.
95% 3.10.
Le. 15.10.
Ø = 63
12 J = 757
16. 9.75 4
22. 7.77 1
20. 8.78 3
13. 9.79 26
19. 9.80 41
6.10.81 7
20. 9.82 5
29. 8.84 6
19. 8.85 7
26. 8.86 29
20. 9.87 9
Jun
Jul
Aug
Sep
Okt
a

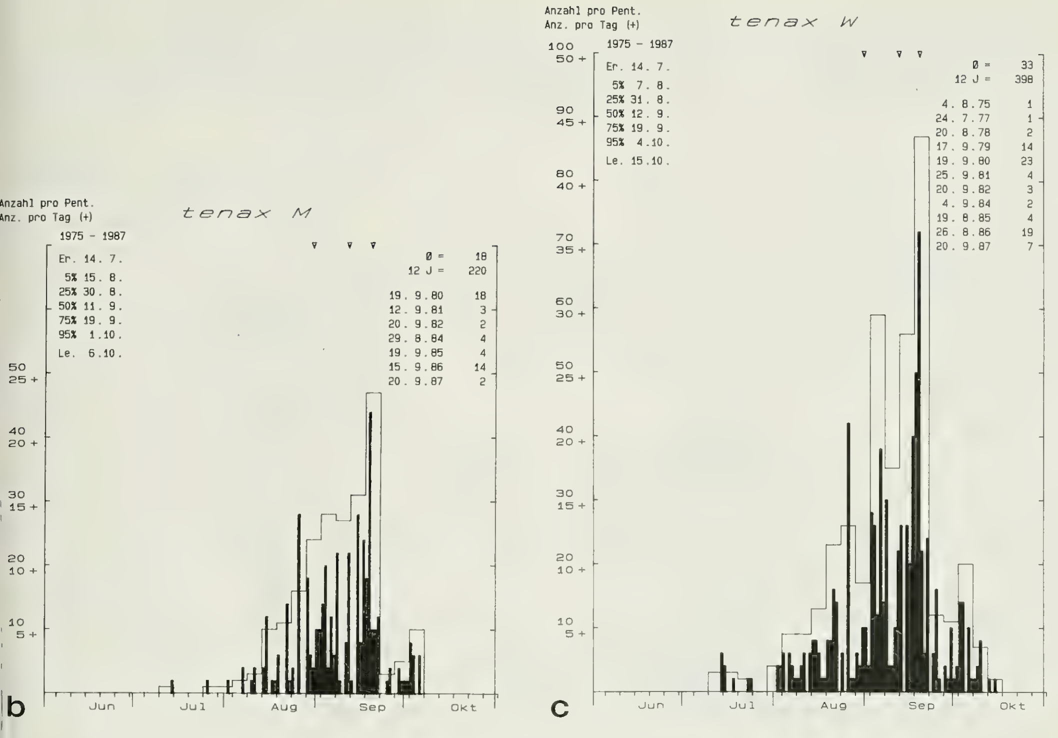


Abb. 20b: Nach Süden gerichtete Migration von *Eristalis tenax*-♂♂ (vgl. Legende zu Abb. 4a).
Fig. 20b: Southbound migration of ♂♂ of *Eristalis tenax.*

Abb. 20c: Nach Süden gerichtete Migration von *Eristalis tenax*-♀♀ (vgl. Legende zu Abb. 4a).
Fig. 20c: Southbound migration of ♀♀ of *Eristalis tenax.*

Als große Insekten können fliegende *Eristalis*-Arten auch im Feld gut angesprochen und über kurze Strecken mit dem Fernglas verfolgt werden. Wie Stichproben ergaben, handelte es sich am Randecker Maar dabei überwiegend um *E. tenax.* Richtungsmessungen ergaben, daß die Fliegen fast ausschließlich nach SW zogen (Gatter 1981a). Dabei entwickeln sie beachtliche Zuggeschwindigkeiten von ca. 25 km/h bei Windstille (Gatter 1981a mit weiteren Einzelheiten).

In den Alpen wurden am Col de Bretolet markierte *tenax* an einem 3 km südwestlich gelegenen Paß innerhalb von 10–15 Minuten wiedergefangen (Aubert et al. 1969).

Phänologie am Randecker Maar: Hier steht *tenax* in der Fangstatistik mit 757 Expl. erst an neunter Stelle (Tab. 2). Frühere Beobachtungen (Gatter & Gatter 1973, Gatter 1975a) belegen allerdings, daß diese geringen Fangzahlen keineswegs Folgen eines nur sehr schwachen Zuggeschehens sind. Gatter (1976) konnte beobachten, daß *tenax* die Reusen gewöhnlich als Hindernisse erkennt und um- oder überfliegt. Trotzdem dürften auch die relativ wenigen Fänge zuverlässig Aufschluß über die Phänologie von *tenax* geben. Das auf den Fängen basierende Diagramm (Abb. 20a) dieser Art mit seinem typischen Schwerpunkt erst im September entspricht im wesentlichen den durch Sichtbeobachtungen gewonnenen Diagrammen bei Gatter (1975a). Auch am Col de Bretolet ist *tenax* die Art mit dem späte-

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Abb. 20a: Nach Süden gerichtete Migration von *Eristalis tenax* (vgl. Legende zu Abb. 4a); eingeschaltet ist das Zugmuster am Col de Bretolet (aus Aubert et al. 1976).
Fig. 20a: Southbound migration of *Eristalis tenax;* the insertion shows the phenology at Col de Bretolet.

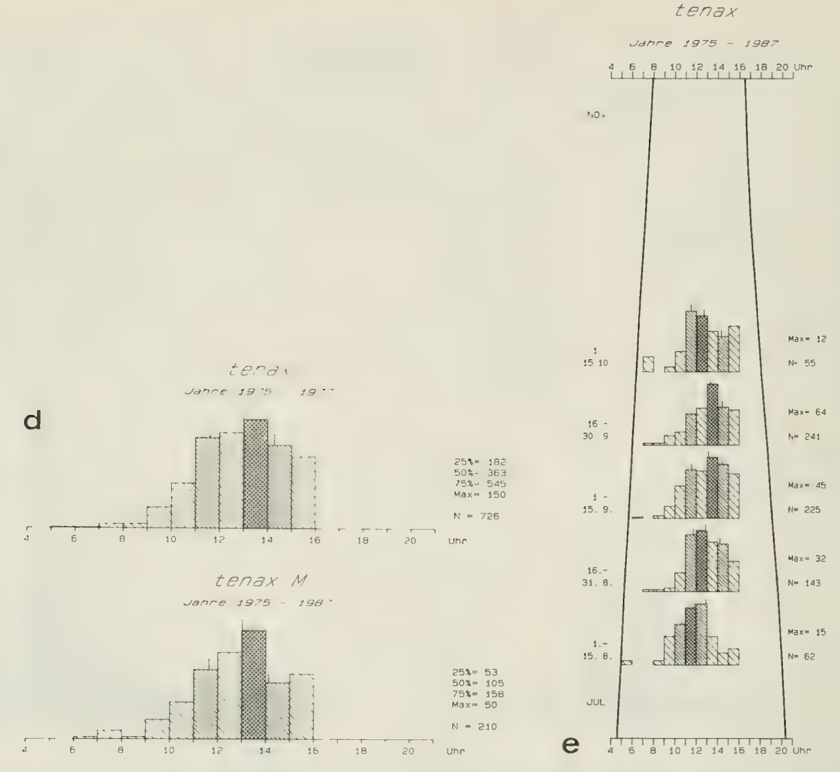


Abb. 20d: Tageszeitliche Verteilung von *Eristalis tenax* (vgl. Legende zu Abb. 4d).
Fig. 20d: Diurnal activity patterns of *Eristalis tenax* migrating southward.

Abb. 20e: Tageszeitliche Verteilung von *Eristalis tenax* im Jahresverlauf (vgl. Legende zu Abb. 5h).
Fig. 20e: Diurnal activity patterns of *Eristalis tenax* migrating southward throughout the year.

sten Maximum (vgl. Abb. 20a). ♀♀ werden am RM etwas häufiger gefangen als ♂♂ (♂♂ : ♀♀ = 1:1,3; n = 701). Die Diagramme für die beiden Geschlechter weichen nicht wesentlich vom Summendiagramm ab (Abb. 20b, 20c).

Auch das tageszeitliche Muster der Reusenfänge (Abb. 20d) bestätigt die durch Sichtbeobachtungen (Gatter 1975a) gewonnenen Daten, nach denen das Gros in der Zeit von ungefähr 10–16 Uhr zieht, während nach 16 Uhr nur noch wenige ziehende *tenax* beobachtet werden können. Mit fortschreitender Jahreszeit verlagert sich der Aktivitätsschwerpunkt vom späten Vormittag auf den frühen Nachmittag (Abb. 20e). Das Aktivitätsmuster der beiden Geschlechter unterscheidet sich nicht wesentlich voneinander.

Eristalis tenax wird Jahr für Jahr in stark wechselnder Anzahl gefangen (Abb. 27n). Die weitaus meisten Tiere geraten dabei in die S-Reuse (S-Reuse : N-Reuse = 46,5:1; n = 285). Gewöhnlich werden sie dort bei Gegenwinden aus SW, S oder SE gefangen (75,8 %, n = 317), nur gelegentlich bei Rükkenwind aus NW, N oder NE (7,5 %) (Abb. 26f).

Status: Saisonaler Migrant.

Die Zahl der im mittleren und nördlichen Europa überwinternden ♀♀ ist, im Vergleich zu der großen Häufigkeit der Art, eher gering. Verlinden & Decleer (1987) vermuten, daß ein großer Teil der Fliegen im Herbst nach Süden zieht. Die großen Zahlen (Hochrechnungen für das Randecker Maar bei Gatter & Gatter 1973) zeigen, daß tatsächlich enorm viele Fliegen an der herbstlichen Wanderung teilhaben.

Direkte Beobachtungen von Frühjahrswanderungen fehlen, jedoch lassen die sehr steil ansteigenden Zahlen im Sommer vermuten, daß Zuwanderung aus dem südlichen Europa für den Aufbau der Sommerpopulationen mit verantwortlich ist. Dabei sind allerdings nicht die Immigranten selber, sondern deren Nachkommen für das Sommermaximum verantwortlich.

Helophilus pendulus (Linnaeus 1758)

Verbreitung: paläarktisch

Biologie: *H. pendulus* ist eine eurytope und oft häufige Art. Die Larven wurden in eutrophen Gewässern, aber auch in sehr nassem Dung und sich zersetzendem pflanzlichen Material gefunden. Die Larven überwintern (Hartley 1961). Die Imagines können zwischen (Ende März) Mitte April und Ende Oktober, gelegentlich auch noch im November und Dezember (Verlinden & Decleer 1987) gesehen werden. Gewöhnlich wird im Juni ein erstes Maximum gebildet. Ihre größte Häufigkeit erreicht die Art aber im Hochsommer (August).

Wanderungen: Am Col de Bretolet erscheint *H. pendulus* zwar nicht in sehr großer Zahl (Tab. 2), aber regelmäßig, so daß Aubert et al. (1976) die Art als Wanderer einstufen. Das Maximum wird hier Mitte September erreicht. Aus Norddeutschland existieren Beobachtungen nicht-ansässiger Tiere von Feuerschiffen (Heydemann 1967) und von der Insel Scharhörn (Schmid 1987). Ein Mai-Nachweis von dort stammt möglicherweise von einem Tier, das sich auf Nordwanderung befand. Regelmäßig wurde die Art erst ab Anfang Juli gesehen.

Phänologie am Randecker Maar: *H. pendulus* wird in der S-Reuse nur wenig seltener gefangen als *Eristalis tenax* (Tab. 2). Der Zughöhepunkt liegt aber früher als bei dieser Art, nämlich an der Monatswende August/September (Abb. 21a). *H. pendulus* ist von den späten Vormittagsstunden bis in den Nachmittag hinein ohne auffälliges Maximum flugaktiv (Abb. 21b). Der „Abendgipfel" kommt durch



Volucella pellucens, eine monovoltine Art ohne saisonale Wanderungen (Ph.: W. Gatter).

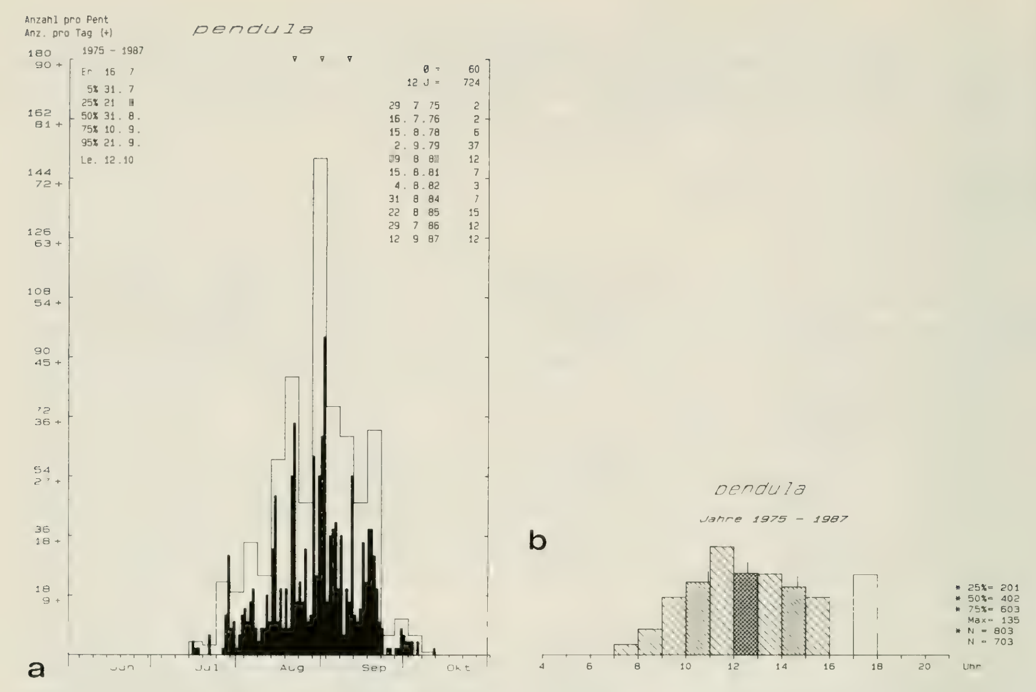


Abb. 21 a: Nach Süden gerichtete Migration von *Helophilus pendulus* (vgl. Legende zu Abb. 4 a).
Fig. 21 a: Southbound migration of *Helophilus pendulus.*

Abb. 21 b: Tageszeitliche Verteilung von *Helophilus pendulus* (vgl. Legende zu Abb. 4 d).
Fig. 21 b: Diurnal activity patterns of *Helophilus pendulus* migrating southward.

die Extrapolation der Beobachtungen von 1975–77 (n = 14) zustande und bezieht sich nur auf zwei gefangene Tiere, ist also zu vernachlässigen. Abb. 27 o zeigt die jährlichen Fangsummen und das Verhältnis der Fangzahlen zwischen beiden Reusen: S-Reuse : N-Reuse = 6,5 : 1 (n = 195).

Status: Saisonaler Migrant.

Helophilus trivittatus (Fabricius 1805)

Vorkommen: paläarktisch

Biologie: Die Larven von *trivittatus* und ihre Habitatansprüche sind nach unserem Wissen noch unbeschrieben. Sie dürften aber denen von *pendulus* ähneln. Auch die Imagines von *trivittatus* sind ebensowenig an bestimmte Habitate gebunden wie die von *pendulus.* In vielen Gebieten ist *trivittatus,* wenn auch nicht so häufig wie *pendulus,* in großer Zahl zwischen (Mitte April) Mitte Mai und Anfang (Mitte) Oktober anzutreffen. Frühjahrsnachweise vor Mitte Mai sind ausgesprochen spärlich. Die größte Häufigkeit wird meist im August und September erreicht.

Wanderungen: Aus den Alpen ist *trivittatus* vom CB als Wanderer mit ausgeprägtem Maximum in der ersten Septemberhälfte bekannt (Tab. 2; Aubert et al. 1976). Williams et al. (1956) fingen 1 Expl. unter migrierenden Syrphiden in den Pyrenäen. Auch aus Norddeutschland gibt es Wanderbeobachtungen von der Insel Scharhörn. Hier wurden die meisten Fliegen Ende August gesehen (Schmid 1987). Im Golf von Biskaya wurde 1 Expl. von *trivittatus* auf offener See gefangen (3. 7. 1957, Weidner 1958). Hinweise auf Wanderungen sind auch Herbstdaten aus Gebieten ohne Sommerbeobachtungen (z. B. Schmid 1986).

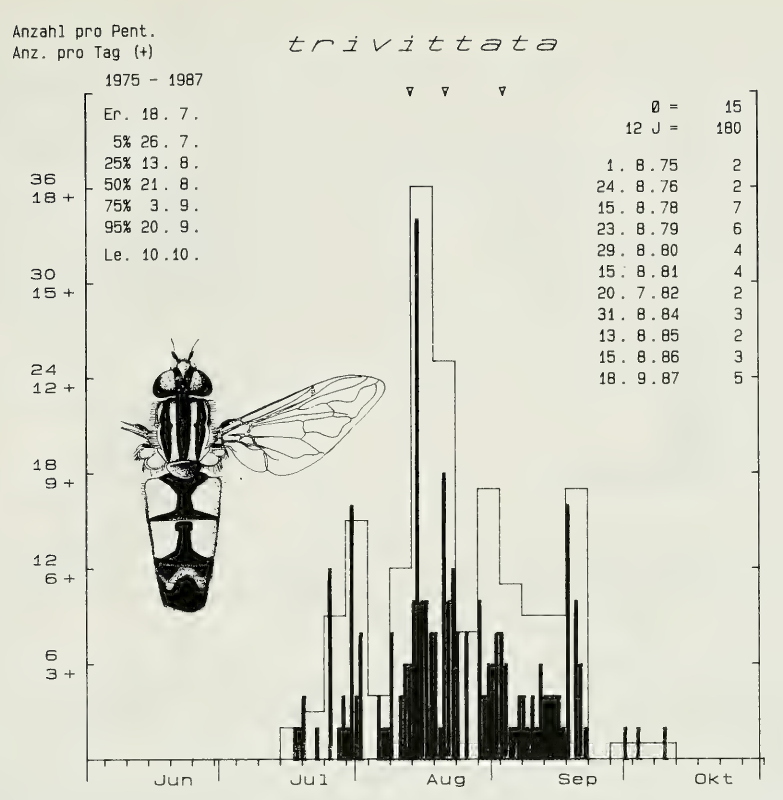


Abb. 22: Nach Süden gerichtete Migration von *Helophilus trivittatus* (vgl. Legende zu Abb. 4a) (eingefügte Zeichnung aus van der Goot 1981).
Fig. 22: Southbound migration of *Helophilus trivittatus.*

Phänologie am Randecker Maar: *H. trivittatus* erscheint zwar nur in geringer Zahl, aber regelmäßig am RM (Tab. 2, Abb. 27p). Die Art wird dabei fast ausschließlich in der S-Reuse (S-Reuse : N-Reuse = 33,5:1; n = 69) bei Gegenwinden aus SW, S oder SE (78,5 %) gefangen (Abb. 26g). Bei Rückenwinden aus NW, N oder NE geraten nur 6,8 % der Fliegen in die S-Reuse. *Trivittatus* wandert überwiegend im August und September (Abb. 22). Das Maximum liegt am RM Ende August, während es am CB erst in der ersten Septemberhälfte erreicht wird.
Status: Saisonaler Migrant.

3.1.4 Schwebfliegen mit phytophagen Larven

Cheilosia pagana (Meigen 1822)

Verbreitung: paläarktisch
Biologie: Die sehr artenreiche Gattung *Cheilosia* ist in den Reusenfängen stark unterrepräsentiert (vgl. Schmid & Gatter 1988). Lediglich die eurytope und häufige *C. pagana,* deren Larven phytophag in Wurzeln des Wiesenkerbels *Anthriscus sylvestris* minieren (Stubbs 1980), wird zahlreich gefangen. *C. pagana* bildet mehrere Generationen. Ihre Flugzeit beginnt gelegentlich schon Mitte März (Kormann 1977), meist jedoch im April und dauert bis Mitte Oktober. Dabei sind oft Maxima im Frühjahr

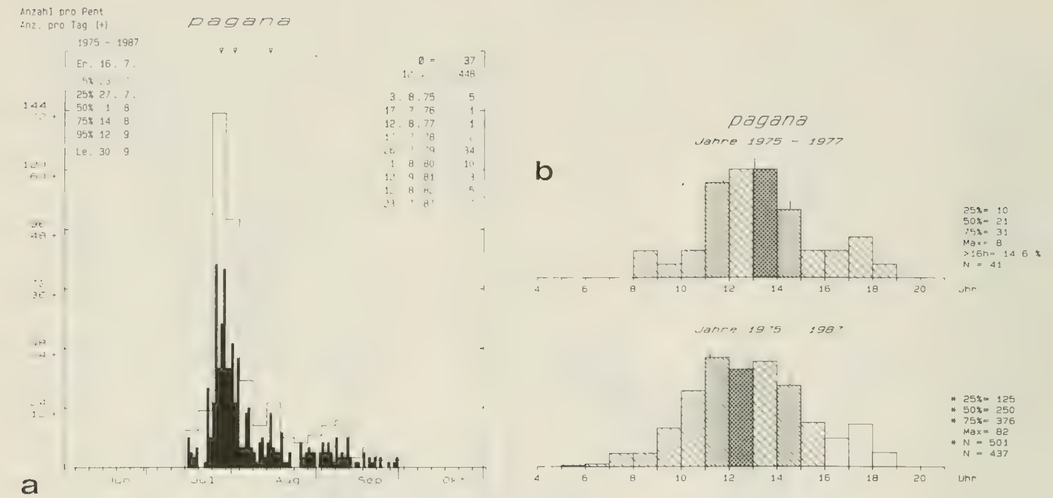


Abb. 23a: Fänge in der S-Reuse von *Cheilosia pagana* (vgl. Legende zu Abb. 4a).
Fig. 23a: Trapped individuals with northerly opening trap (S-trap) of *Cheilosia pagana.*
Abb. 23b: Tageszeitliche Verteilung von *Cheilosia pagana* (vgl. Legende zu Abb. 4d).
Fig. 23b: Diurnal activity patterns of *Cheilosia pagana.*

und im Hochsommer deutlich. In welchem Entwicklungsstadium *pagana* überwintert, wird bei Stubbs (1980) nicht deutlich. Zahlreiche *Cheilosia*-Arten überwintern als Puparium (z. B. Rotheray 1988, Smith 1979).

Wanderungen: Beobachtungen von Wanderungen fehlen bei sämtlichen *Cheilosia*-Arten. Am Col de Bretolet sind zwar zahlreiche Arten nachgewiesen (Aubert et al. 1976), aber selbst im Bereich der alpinen Matten lebende *Cheilosien* wurden nur in sehr geringer Zahl gefangen – Hinweis auf die im allgemeinen sehr geringe Mobilität der Tiere. *C. pagana* ist nur mit 10 Expl. vertreten.

Phänologie am Randecker Maar: Auch die hohe Zahl von *pagana*-Fängen in den Reusen (Tab. 2) dürfte nicht Ausdruck einer Wanderbewegung sein, sondern auf eine große ansässige Population zurückgehen. Das an Doldenblütlern reiche Busch- und Wiesengelände der Stationsumgebung ist für *pagana* ein idealer Lebensraum. Das Diagramm (Abb. 23a) spiegelt die lokale Häufigkeit der Art gegen Ende des Hochsommer-Maximums wider.

Das Aktivitätsmaximum dieser Art liegt um die Mittagsstunden (Abb. 23b).

Der Unterschied zwischen den Reusen (S-Reuse : N-Reuse = 3,1:1; n = 232; Abb. 27q) geht vermutlich auf die kleinräumigen Unterschiede im vor der Reusenöffnung gelegenen Lebensraum zurück (vgl. *Rhingia campestris, Neoascia podagrica).*

Status: Polyvoltine Art ohne oder mit sehr geringer saisonaler Dismigrationsneigung.

3.2 Weitere Wanderarten in Europa

Nicht alle in Europa bisher wandernd beobachteten Syrphidenarten konnten am RM in einer zur Klärung ihres Status hinreichend großen Zahl beobachtet werden. Deshalb soll hier zunächst ein Überblick über diese Arten gegeben werden.

Die meisten Beobachtungen stammen vom Col de Bretolet. Hier konnten insgesamt 186 Schwebfliegenarten nachgewiesen werden (Aubert et al. 1976), von denen 30 als wandernd oder zumindest als wanderverdächtig eingestuft wurden. In welche Kategorie diese Arten am CB eingestuft wurden, ist jeweils sowohl übersetzt als auch im Wortlaut zitiert.

3.2.1 Schwebfliegen mit zoophagen Larven

Platycheirus scutatus (Meigen 1822)

Verbreitung: holarktisch

CB: n = 186, während der ganzen Beobachtungsperiode verteilt, vielleicht Wanderart („peut-être migratrice"); RM: n = 16, nur in zwei Jahren beobachtet.

Die Art ist im allgemeinen zahlreich. Sie kommt in Mitteleuropa von (Anfang April) Anfang Mai bis Mitte Oktober (Anfang November) vor und bildet i. a. zwei Generationen (Krüger 1926) die als deutliche Maxima erkennbar sind (Verlinden & Decleer 1987). Angesichts der Spärlichkeit der Fänge ist regelmäßiges Wandern in größerem Ausmaß ausgeschlossen. Gelegentliche Dismigrationen können vorkommen (vgl. Schmid 1987). Die im Larvenstadium an Blattlauskolonien der Krautschicht lebende, obligatorisch aphidophage (Rotheray & Gilbert 1989) Art kann als Saisonaler Dismigrant mit geringer Migrationsneigung betrachtet werden.

Xanthandrus comtus (Harris 1780)

Verbreitung: paläarktisch, orientalisch (Formosa)

CB: n = 441, Herbstwanderart („Migrateur automnal") mit Maximum Mitte Oktober und Vorkommen 7.7.–21.10. Von den 441 Expl. allein 231 Expl. in einem Jahr; RM: n = 17.

Die in Mitteleuropa zwischen Mitte Mai und Mitte Oktober mit einem deutlichen Schwerpunkt im Spätsommer vorkommende Art ist meist recht selten. Gelegentliches häufigeres Vorkommen könnte mit Gradationen der Nahrungstiere zusammenhängen: *comtus*-Larven fressen v. a. Schmetterlingsraupen, insbesondere Gespinstmotten (Yponomeutidae) und Wickler (Tortricidae), aber auch Kiefernprozessionsspinner *(Thaumetopoea pinivora* Tr.) (weitere Nahrungstiere in der Zusammenfassung von Torp [1984]). Snow & Ross (1952) fingen *comtus* am 21.9. unter wandernden Syrphiden in den Pyrenäen. Weitere Hinweise auf Wanderungen fehlen. Der Status der Art erscheint weiterhin ungeklärt.

Metasyrphus lapponicus (Zetterstedt 1838)
= *Eupeodes lapponicus*

Verbreitung: holarktisch

CB: n = 10235, während der ganzen Beobachtungsperiode anwesend, Maximum variiert von Jahr zu Jahr („Migrateur"); RM: n = 4.

M. lapponicus gehört zu den Arten, die in Mitteleuropa als Imago überwintern (Schneider 1958, Goeldlin 1974, Dušek & Láska 1986) und kann deshalb schon früh im Jahr beobachtet werden (März). Auch im Herbst ist die Art lange aktiv (November). Die Flugzeitangaben aus dem nördlichen Mitteleuropa und Nordeuropa (Belgien: Anfang April bis Ende August [Verlinden & Decleer 1987], Niederlande: Ende Mai bis Anfang August [van der Goot 1981], Südnorwegen: Ende Mai bis Mitte August [Nielsen 1971], Schleswig: Mitte Mai bis Mitte August [Claußen 1981], Dänemark: Ende Mai bis Anfang September [Torp 1984]) zeigen, daß hier keine Überwinterung stattfindet. Die fehlenden Spätherbstdaten lassen vermuten, daß eine Überwinterung auch nicht versucht wird. Die Art muß in diese Gebiete also alljährlich einwandern. – *M. lapponicus* ist in Mitteleuropa in den meisten Jahren eine eher seltene, waldbewohnende Art; nur gelegentlich ist sie häufiger anzutreffen. In den Alpen ist *lapponicus* dagegen stets zahlreich. Möglicherweise ist das der Hauptgrund für die geringen Zahlen am RM und den stärkeren Durchzug am CB mit Jahressummen zwischen 82 und 3765 Exemplaren.

Ein Hinweis auf Wandertendenzen dieser Art im Mittelgebirgsbereich ist z. B. die Bemerkung von Malec (1986) aus dem Kasseler Raum, daß *lapponicus* im Herbst „mobiler" zu sein scheine und dann

selbst in Großstadtgärten anzutreffen sei. Im Sommer 1989 war *lapponicus* nach einem sehr blattlausreichen Frühling auch um Tübingen (SW-Deutschland) ungewöhnlich zahlreich und immer wieder in Gärten und selbst in Häusern zu finden (Schmid unveröff.). Möglicherweise beziehen sich auch Hinweise auf Wanderungen von „*Syrphus arcuatus*" in Südengland bei Walker (1864) auf *lapponicus* – allerdings ist die Art in Großbritannien selten (Stubbs & Falk 1983).

Aufgrund ihres Lebenszyklus und der Flugzeiten in Mittel- und Nordeuropa ist zu erwarten, daß *M. lapponicus* zu den Saisonalen Migranten gehört.

Metasyrphus latifasciatus (Macquart 1829)
= *Eupeodes latifasciatus*

Verbreitung: holarktisch

CB: n = 4909, während der ganzen Beobachtungsperiode anwesend, undeutliches Maximum Anfang September („Migrateur"); RM: n = 20.

Der Lebenszyklus dieser Art entspricht weitgehend dem von *M. corollae;* allerdings scheint noch nicht bekannt zu sein, in welcher Form die Überwinterung stattfindet. Typisch für *latifasciatus* sind die extremen Häufigkeitsunterschiede von Jahr zu Jahr (Stubbs & Falk 1983, Verlinden & Decleer 1987). Am RM wurde die Art in vielen Jahren gar nicht beobachtet. *M. latifasciatus* ist eurytop mit einer Vorliebe für offene und feuchte Habitate. Sie fliegt ab Anfang April bis Anfang Oktober und bildet mehrere Generationen. Um den Status der Art zu klären, bedarf es weiterer Beobachtungen.

Metasyrphus luniger (Meigen 1822)
= *Eupeodes luniger*

Verbreitung: paläarktisch, nordorientalisch (Assam)

CB: n = 12002, während der ganzen Beobachtungsperiode anwesend, Maximum variiert („Migrateur"); RM: n = 7.

Wie *M. corollae* ist auch *luniger* eine polyvoltine Art, die als Puparium überwintert (Scott 1939, Dušek & Láska 1974). Möglicherweise können gelegentlich auch Imagines überwintern (Gauss 1961, Nielsen 1971), der Normalfall ist dies aber sicher nicht (Dušek & Láska 1986). Die Larven von *luniger* leben von zahlreichen Blattlausarten (Láska & Starý 1980) überwiegend in der Krautschicht (Dixon 1960, Rotheray & Gilbert 1989). *M. luniger* kann gewöhnlich zwischen Mitte April und Oktober beobachtet werden, gelegentlich auch noch später (9 ♀♀ am 17. 12., [Schneider 1958]). Die früher oft als häufig und weit verbreitet bezeichnete Art ist heute vielerorts ausgesprochen selten. Torp (1984) spricht von einem sicheren Rückgang der Art in Dänemark. Dies dürfte für die wenigen Nachweise der Art am RM mit verantwortlich sein. Der mit *corollae* übereinstimmende Lebenszyklus macht wahrscheinlich, daß auch *M. luniger* zu den Saisonalen Migranten gehört, wenn auch Wanderdaten nur spärlich vorliegen (z. B. Johnson 1960, Schmid 1987).

Dasysyrphus albostriatus (Fallén 1817)

Verbreitung: paläarktisch

CB: n = 548, Maximum Mitte September („Migrateur"); RM: n = 13.

D. albostriatus hat einen unter mitteleuropäischen Schwebfliegen ungewöhnlichen Lebenszyklus: die Art ist bivoltin mit Hauptflugzeit im Frühjahr und Herbst und obligatorischer Larvendiapause (Schneider 1948). Die zweigeteilte Flugzeit ermöglicht *albostriatus* die Ausbeutung des Frühjahrs- wie des Herbstmaximums der Blattlauspopulationen (Dušek & Láska 1986). Die Art ist hauptsächlich in Wäldern und an Waldrändern weit verbreitet, meist aber nur in geringer Anzahl anzutreffen. *Dasysyrphus*-Larven leben aphidophag überwiegend auf Laub- und Nadelbäumen (Rotheray & Gilbert 1989).

Am CB erscheint *albostriatus* vereinzelt ab Mitte Juli. Bis Anfang September steigern sich die Fangzahlen kontinuierlich, dann nehmen sie bis Anfang Oktober wieder ab. Hier spiegelt sich die Flugzeit der Herbstgeneration getreulich wider. Vermutlich wandert *D. albostriatus* allenfalls in geringem Ausmaß und ist als Saisonaler Dismigrant mit geringer Migrationsneigung zu betrachten.

Melangyna cincta (Fallén 1817)

Verbreitung: Westliche Paläarktis, Nearktis

CB: n = 1075, deutliches Maximum Ende August/Anfang September, bis Mitte September sehr schnelle Abnahme der Zahlen („Migrateur"); RM: n = 16.

Von Mitte April bis Mitte September kann diese Art vor allem in Wäldern und an Waldrändern angetroffen werden. Ihre Larven wurden an Blattläusen auf Buchen *(Fagus sylvatica)* gefunden (Láska & Starý 1980). Innerhalb ihrer Flugzeit ist ein ausgeprägtes Maximum im Frühjahr (Mai bis Anfang Juni) ausgebildet. Im Sommer kann ein zweiter, schwächerer Höhepunkt ausgebildet sein. Dušek & Láska (1962, 1986) halten *cincta* für eine univoltine Art; die Sommerdaten stammen demnach von verfrüht geschlüpften und nicht erfolgreich fortpflanzungsfähigen Individuen. *M. cincta* kann am besten mit Malaisefallen erfaßt werden (Schmid 1986, Verlinden & Decleer 1987); Angaben über die Häufigkeit im Vergleich zu anderen Arten lassen sich somit nach Kescherfängen schlecht machen. Insgesamt scheint *cincta* nicht selten zu sein, aber sehr starke Populationsschwankungen aufzuweisen (z. B. Malec 1986). – Der Status der Art erscheint unklar. Weitere Beobachtungen sind notwendig.

Parasyrphus annulatus (Zetterstedt 1838)

Verbreitung: paläarktisch

CB: n = 1786, Maximum zu Beginn der Beobachtungen im Juli („Migrateur probable"); RM: 3 Ex.

P. annulatus kann zwar gelegentlich bis in den Herbst hinein angetroffen werden, kommt aber nur im Frühjahr in so großer Anzahl vor, daß sie lokal – so z. B. im Tübinger Raum (Schmid 1986), am Alpennordrand (Schmid unveröff.) oder in der Westschweiz (Goeldlin 1974) – sehr häufig sein kann. Möglicherweise ist die im Larvenstadium an Blattläusen in Fichtenwäldern (Kula 1980) gefundene Art univoltin (z. B. Niederlande: Beobachtungen nur Mitte Mai bis Anfang Juli [van der Goot 1981]) mit der Tendenz der Ausbildung einer zweiten Generation (vgl. *Melangyna cincta).* Überwintern dürfte die diapausierende Larve. Von Arten mit einem solchen Entwicklungstyp sind keine gerichteten Saisonwanderungen bekannt. *P. annulatus* führt Saisonale Dismigrationen im Zusammenhang mit der Suche nach geeigneten Eiablageplätzen durch. Dafür spricht auch, daß in einem als Malaisefalle arbeitenden Gebäude am Rand von Tübingen ganz überwiegend ♀♀ gefangen wurden (Schmid 1986 und unveröff.).

Parasyrphus punctulatus (Verrall 1873)

Verbreitung: Europa, Altai

Auch die ♀♀ dieser ebenfalls nur in einer Frühjahrsgeneration auftretenden Art führen wie *P. annulatus* saisonale Dismigrationen aus (vgl. Schmid 1986). Auch *punctulatus* ist eine aphidophage Art, die überwiegend, wenn auch nicht ausschließlich an Nadelbäumen lebt. Rotheray & Gilbert (1989) geben Funde von *Abies, Pinus, Acer pseudoplatanus* und *Rosa* an. Bei Tübingen wurden Mitte Mai 1988 zahlreiche ♀♀ bei der Eiablage an verlausten Fichtentrieben *(Picea abies)* beobachtet (Schmid unveröff.).

Parasyrphus vittiger (Zetterstedt 1843)

Verbreitung: paläarktisch

CB: n = 1568, undeutliches Maximum Ende August („Migrateur"); RM: 4 Ex.

Auch diese im allgemeinen eher seltene, im Larvenstadium an Blattläusen auf Tanne, Kiefer und Johannisbeere *(Ribes nigrum)* lebende Art (Goeldlin 1974, Rotheray & Gilbert 1989) hat eine relativ lange Flugzeit (Mitte April bis Mitte Oktober). Im Tübinger Raum existiert ein ausgeprägtes Frühjahrsmaximum (Schmid 1986). Hinweise darauf fehlen andernorts, so daß ungeklärt ist, wie viele Generationen *vittiger* normalerweise ausbildet. In den Alpen kommt *vittiger* zahlreich bis über die Waldgrenze vor (Goeldlin 1974, eigene Beobachtungen). Der Status dieser Art dürfte dem von *P. annulatus* entsprechen: Saisonale Dismigration.

Didea alneti (Fallén 1817)

Verbreitung: holarktisch

CB: n = 817, ab Mitte Juli bis Ende September mit einem wenig ausgeprägten Maximum Ende August („considéré comme migrateur"); RM: n = 2.

D. alneti fliegt zwischen Mitte Mai und Mitte Oktober ohne deutliche Höhepunkte, dürfte also polyvoltin sein. Diese aphidophage Art scheint nirgends zahlreich vorzukommen. Wanderhinweise abseits des CB fehlen. Der Status der Art ist unklar.

Didea fasciata Macquart 1834

Verbreitung: holarktisch, orientalisch (Formosa)

CB: n = 3171, ausgeprägtes Maximum Ende Juli/Mitte August („Migrateur"); RM: n = 11.

Die Flugzeit dieser in Wäldern, aber auch in Gärten anzutreffenden, aphidophagen Art beginnt Ende April und endet Ende Oktober. Maxima liegen in Dänemark Mitte Juni und Anfang August (Torp 1984), in Belgien im August. Verlinden & Decleer (1987) vermuten, daß dieses Maximum durch Wanderer verursacht wird. Direkte Hinweise auf Wanderungen gibt es außer vom CB nur noch aus der Steiermark (Gepp 1975) und aus den Pyrenäen (1 Ex. am 10. 10.; Williams et al. 1956). Der Status von *D. fasciata* bedarf weiterer Klärung.

Meliscaeva auricollis (Meigen 1822)

Verbreitung: Westliche Paläarktis

CB: n = 3127, Maximum Ende September („Migrateur"); RM: n = 11.

Wie bei der sehr nahe verwandten Art *Episyrphus balteatus* können die ♀♀, wie Schneider (1948) im Alpenraum nachwies, als Imagines überwintern. Goeldlin (1974) nennt für die Westschweiz eine Flugzeit von Februar bis November. Nördlich der Alpen scheint die Überwinterung nur in Ausnahmefällen zu glücken. Hier erscheint *auricollis* nur in Ausnahmefällen schon im Februar (Großbritannien [Stubbs & Falk 1983]) oder im März (ein Fund am 26. 3. in Belgien [Verlinden & Decleer 1987]). Normalerweise fliegt die Art erst ab Mitte April, im Norden sogar erst ab Mai. Torp (1984) vermutet, daß die dänische Population alljährlich von Einwanderern aufgebaut wird. Wandernde Exemplare wurden auch in Südengland (Mackworth-Praed 1929) und auf der Insel Scharhörn festgestellt (Schmid 1987).

Die Larven von *auricollis* sind aphidophag und bewohnen Bäume, Büsche und Kräuter. Auch in Kolonien von Blattflöhen (Psyllidae) konnten sie gefunden werden (Dixon 1960, Láska & Starý 1980, Rotheray & Gilbert 1989). *Meliscaeva auricollis* ist zwar sehr weit verbreitet, kommt aber meist nur vereinzelt vor. Das erklärt ihre Seltenheit am RM. Der fast völlig mit dem von *Episyrphus balteatus* übereinstimmende Lebenszyklus dieser Art und ihre Phänologie in Mitteleuropa machen sehr wahrscheinlich, daß auch sie zu den Saisonalen Migranten gehört.

3.2.2 Schwebfliegen mit terrestrischen saprophagen Larven

Xylota segnis (Linnaeus 1758)

Verbreitung: Westliche Paläarktis, nearktisch
CB: n = 130, einzelne Exemplare zwischen dem Beginn der Beobachtungsperiode und Anfang Oktober; die Art könnte Wanderer sein? („pourrait être migrateur?") [dagegen Aubert mdl. an Gatter: die Art wandert nicht]; RM: n = 47.

Diese häufigste und am weitesten verbreitete *Xylota*-Art kann zwischen (Ende März) Anfang Mai und Mitte Oktober (Anfang November) beobachtet werden. Ihre Larven leben in vermoderndem Holz, in nassem Sägemehl oder auch in Silage (Hartley 1961). Sie überwintern und verpuppen sich im Frühjahr. In SW-Deutschland werden vermutlich drei Generationen gebildet (Schmid 1986). Die ♂♂ dieser Art verhalten sich territorial. Vor allem legereife ♀♀ zeigen dagegen ein ausgeprägtes saisonales Dismigrationsverhalten, wohl auf der Suche nach Eiablageplätzen (Schmid l. c.). Weiterführende Wanderungen finden nicht statt.

Xylota florum (Fabricius 1805)

Verbreitung: paläarktisch
CB: n = 24; RM: n = 0.
Ein dem von *X. segnis* entsprechendes, vor allem von ♀♀ ausgeführtes, saisonales Dismigrationsverhalten zeigt auch die nahe verwandte *X. florum*. Diese Art wird deshalb ebenfalls sehr zahlreich in Einflugfallen gefangen (vgl. Löhr 1987, Schmid 1986).

Xylota sylvarum (Linnaeus 1758)

Verbreitung: paläarktisch
CB: n = 7; RM: n = 15.
Auch *sylvarum* wird nicht selten in Einflugfallen gefangen (Löhr 1987, Schmid 1986). Hier sind ebenfalls fast ausschließlich ♀♀ an der nur über kurze Distanzen reichenden Saisonalen Dismigration beteiligt, während die ♂♂ ein ausgesprochenes Territorialverhalten an den Tag legen (Schmid 1986).

3.2.3 Schwebfliegen mit sapro-/zoophagen Larven

Volucella zonaria (Poda 1761)

Verbreitung: südliche Paläarktis
Volucella-Larven leben in Nestern von Hummeln und Wespen. Dort ernähren sie sich einerseits von Abfällen und toten Tieren, andererseits zumindest gelegentlich auch von den Larven ihrer Wirte (vgl. Torp 1984).

Volucella zonaria ist eine im Mittelmeergebiet sehr zahlreich vorkommende Art. Im Hochsommer (meist August) wandern immer wieder einzelne dieser großen und sehr auffälligen Schwebfliegen in Mitteleuropa ein. Gelegentlich kommt es zu zahlenstärkeren Einflügen (z. B. van der Goot 1986b). Fast alle dieser Einwanderer sind weiblich. Infolge solcher expansiver Dismigrationen kann es zu Arealerweiterungen kommen: *V. zonaria* etablierte sich in den 1940er Jahren in Südengland und ist seither dort heimisch. Bis 1960 war die Art dort relativ häufig. In den letzten Jahren wurde sie wieder seltener (Gilbert 1986). Diese Beobachtungen decken sich mit Arealausweitungen und -verlusten mediterraner Vogelarten in Mitteleuropa. Im Zusammenhang mit einer längeren Klimaphase mit hohen Sommertemperaturen und geringen Niederschlägen in der Mitte des 20. Jahrhunderts dehnten solche

Arten ihr Verbreitungsgebiet weit in den mitteleuropäischen Raum hinein aus. Die in den 1970er Jahren einsetzende, für diese Arten ungünstige Klimaphase mit feuchteren und kühleren Sommern führte wieder zu starken Arealverlusten. Sowohl die Ansiedlung von *Volucella zonaria* in Südengland wie ihre zunehmende Seltenheit in den letzten Jahren dürften auf dieselben klimatischen Ursachen zurückgehen.

Status: Expansiver Dismigrant.

Die Neigung zu expansiven Dismigrationen ermöglicht *Volucella zonaria* eine schnelle Reaktion auf wechselnde Umweltbedingungen.

3.3 Übersicht über die Wanderschwebfliegen Europas

Tabelle 3: Übersicht über die Wanderschwebfliegen Europas.
Tab. 3: Migratory hoverfly species of Europe.

	Larvennahrung	Überwinterung	Lebenszyklus #
Saisonale Migranten			
Syrphus ribesii	Blattläuse	Larve	3
Syrphus torvus	Blattläuse	Larve	3
Syrphus vitripennis	Blattläuse	Larve	3
Metasyrphus corollae	Blattläuse	Puparium	2
Metasyrphus lapponicus	Blattläuse	Imago	1
Metasyrphus luniger	Blattläuse	Puparium	2
Scaeva pyrastri	Blattläuse	Imago	1
Scaeva selenitica	Blattläuse	Imago	1
Meliscaeva auricollis	Blattläuse	Imago	1
Meliscaeva cinctella	Blattläuse	(Imgao?)	(?1)
Episyrphus balteatus	Blattläuse	Imago	1
Sphaerophoria scripta	Blattläuse	Larve	3
Eristalis tenax	aquat. sapro-/microphag	Imago	
Helophilus pendulus	aquat. sapro-/microphag	Larve	
Helophilus trivittatus	aquat. sapro-/microphag	(Larve?)	
Saisonale Migranten mit geringer Wanderneigung			
Eristalis arbustorum	aquat. sapro-/microphag	Larve	
*Eristalis interrupta**	aquat. sapro-/microphag	Larve	
Eristalis pertinax	aquat. sapro-/microphag	Larve	
Saisonale Dismigranten			
Platycheirus albimanus	Zoophag in der Streuschicht, Blattläuse	Larve	3
Platycheirus clypeatus	Zoophag in der Streuschicht, Blattläuse	Larve	3
*Platycheirus manicatus**	Blattläuse (fakultativ)	Larve	3
Platycheirus peltatus	Blattläuse (fakultativ)	Larve	3
Melanostoma mellinum	Blattläuse, zoophag in der Streuschicht	Larve	3
Parasyrphus annulatus	Blattläuse	Larve	(?4)
*Parasyrphus lineolus**	Blattläuse	Larve	(?3)

Parasyrphus punctulatus	Blattläuse	Larve	(?7)
Parasyrphus vittiger	Blattläuse	Larve	?
Xylota florum	terrestrisch saprophag	Larve	
Xylota segnis	terrestrisch saprophag	Larve	
Xylota sylvarum	terrestrisch saprophag	Larve	
Saisonale Dismigranten mit geringer Wanderneigung			
Melanostoma scalare	Blattläuse, zoophag in der Streuschicht	Larve	3
Platycheirus scutatus	Blattläuse	Larve	3
Dasysyrphus albostriatus	Blattläuse	Larve	6
Neoascia podagrica	terrestrisch saprophag	Larve	
Syritta pipiens	terrestrisch saprophag	Larve	
Expansive Dismigranten			
Volucella zonaria	sapro- und zoophag in Wespen- und Hummelnestern	(Larve?)	
Status ungeklärt			
Xanthandrus comtus	Schmetterlingsraupen, Blattläuse	Larve	(?5)
Metasyrphus latifasciatus	Blattläuse	?	(?2, ?3)
Melangyna cincta	Blattläuse	Larve	4
Didea alneti	Blattläuse	Larve	(?3)
Didea fasciata	Blattläuse	Larve	(?3)

*: Status nicht ganz sicher

#: Aufbauend auf Schneider (1948, 1969) geben Dušek & Láska (1986) einen Überblick über die Lebenszyklen der aphidophagen Syrphiden. Sie unterschieden (vereinfacht) folgende Typen (der letztgenannte Typ 7 ist vorerst nur bei einer Art verifiziert (Dušek & Láska 1986), kommt aber möglicherweise noch bei anderen Frühjahrsarten vor):

1 mehrere Generationen im Jahr, Überwinterung als Imago.

2 mehrere Generationen, Überwinterung als Puparium.

3 mehrere Generationen, Überwinterung als Larve.

4 eine Generation, Überwinterung als Larve, Flugzeit: Frühjahr.

5 eine Generation, Überwinterung als Larve, Flugzeit: Herbst.

6 zwei Generationen, Überwinterung als Larve, Flugzeit: Frühjahr und Herbst.

7 eine Generation im Frühjahr, Verpuppung im Herbst, Überwinterung als Puparium.

Bei Arten, deren Lebenszyklus noch nicht genauer beschrieben wurde, wird der aus der Phänologie der Imagines geschlossene wahrscheinliche Zyklus in Klammern angegeben.

3.4 Wanderaktivität in Abhängigkeit von den Windverhältnissen

Unter den Wetterfaktoren, die Insektenwanderungen am stärksten beeinflussen, kommt dem Wind eine herausragende Bedeutung zu (Gatter 1975, 1977a, 1977b). Die Beziehungen zwischen Schwebfliegenwanderungen und Windverhältnissen sollen deshalb ausführlicher dargestellt werden.

Im folgenden wird zunächst das Verhalten des Saisonwanderers *Episyrphus balteatus* und des Dismigranten *Platycheirus clypeatus* genauer analysiert.

Dazu werden zuerst Daten aus dem Jahr 1986 miteinander verglichen. In diesem Jahr waren beide Arten annähernd gleich häufig. Anschließend werden die Verhältnisse im Jahr 1981 dargestellt. Aus diesem Jahr liegen Daten aus beiden Reusen vor.

3.4.1 *Episyrphus balteatus* 1986

Abb. 24a zeigt, daß *balteatus* ganz überwiegend bei Gegenwind gefangen wird. Das größte Kontingent bilden bei S- oder SW-Winden mit Stärken von 2–4 Bft. erfaßte Tiere. Dieses scheinbar paradoxe Phänomen ließ sich am Randecker Maar durch Beobachtungen klären. Demnach nutzen die Fliegen fördernde Rückenwinde aus, indem sie in größere Höhen aufsteigen. Den widrigen Einfluß von Gegenwinden versuchen sie dagegen dadurch zu verringern, daß sie bodennah ziehen. Bei mäßigen Gegenwinden geraten deshalb die weitaus meisten Tiere in die S-Reuse.

Schwebfliegen wie *Episyrphus balteatus* zeigen also ein Verhalten, wie es auch bei migrierenden Schmetterlingen (Gatter 1981a) oder ziehenden Vögeln beobachtet werden kann.

Die Strategie des Unterfliegens widriger Gegenwinde wird am RM an vielen Tagen, an denen der Wind dreht, deutlich (vgl. Gatter 1981b). Bei Gegenwinden fängt sich *balteatus* in großer Zahl in der Reuse; sobald der Wind dreht, lassen die Fangzahlen schlagartig nach (Tab. 4). Stichprobenhafte Beobachtungen mit dem Fernglas zeigen dann häufig hohen Zug (vgl. 3.4.6.1).

3.4.2 *Platycheirus clypeatus* 1986

Der Saisonale Dismigrant *P. clypeatus* zeigt ein anderes Verhalten als der Saisonmigrant *Episyrphus balteatus.* Ein großer Teil gelangt mit schwachen Rücken- oder Seitenwinden (1–2 Bft.) in die S-Reuse (Abb. 24b). Die Art scheint demnach keine dem Verhalten von *balteatus* entsprechende Strategie der Nutzung günstiger Luftströmungen durch Aufsteigen in höhere Luftschichten zu haben.

Die Art wurde 1986 gewöhnlich bei etwas schwächeren Winden gefangen als *E. balteatus* (Abb. 25a).

Abb. 24: (Seite 77) Windrichtung und Windstärke bei Wanderungen von *Episyrphus balteatus* und *Platycheirus clypeatus* in ausgewählten Jahren.

Für einzelne Jahre wurden für sämtliche Individuen der jeweiligen Art Windrichtung und -stärke zum Zeitpunkt des Fanges dargestellt. Die Diagramme zeigen, wie viele Individuen (in Prozent) bei welcher Windrichtung und -stärke in der S-Reuse oder N-Reuse gefangen wurden. Die Zahlen geben den Anteil (in Prozent) am Gesamtfang an. (Ablesebeispiel: 24a; 41,7 % aller im Jahr 1986 in der S-Reuse gefangenen *balteatus* wurden bei S-Wind gefangen, die meisten davon bei Windstärken von 3 und 4 Bft.).

Fig. 24: Wind direction and wind force during migration of *Episyrphus balteatus* and *Platycheirus clypeatus* in selected years.

In each year for all specimens, wind direction and force at the time of trapping are shown. The diagrams indicate how many individuals (in %) were collected in different wind conditions. (Example: Fig. 24a; 41,7 % of all catches of *E. balteatus* in 1986 in the trap opening to the north are collected with a southerly wind, most of them at wind forces of 3 and 4 Bft.). S-trap: trap with opening to the north (for south-flying insects); N-trap: trap with opening to the south (for north-flying insects).

a) *E. balteatus*, S-Reuse/S-trap, 1986, n = 2937
b) *P. clypeatus*, S-Reuse/S-trap, 1986, n = 3485
c) *E. balteatus*, S-Reuse/S-trap, 1981, n = 4244
d) *P. clypeatus*, S-Reuse/S-trap, 1981, n = 1528
e) *E. balteatus*, N-Reuse/N-trap, 1981, n = 355
f) *P. clypeatus*, N-Reuse/N-trap, 1981, n = 987

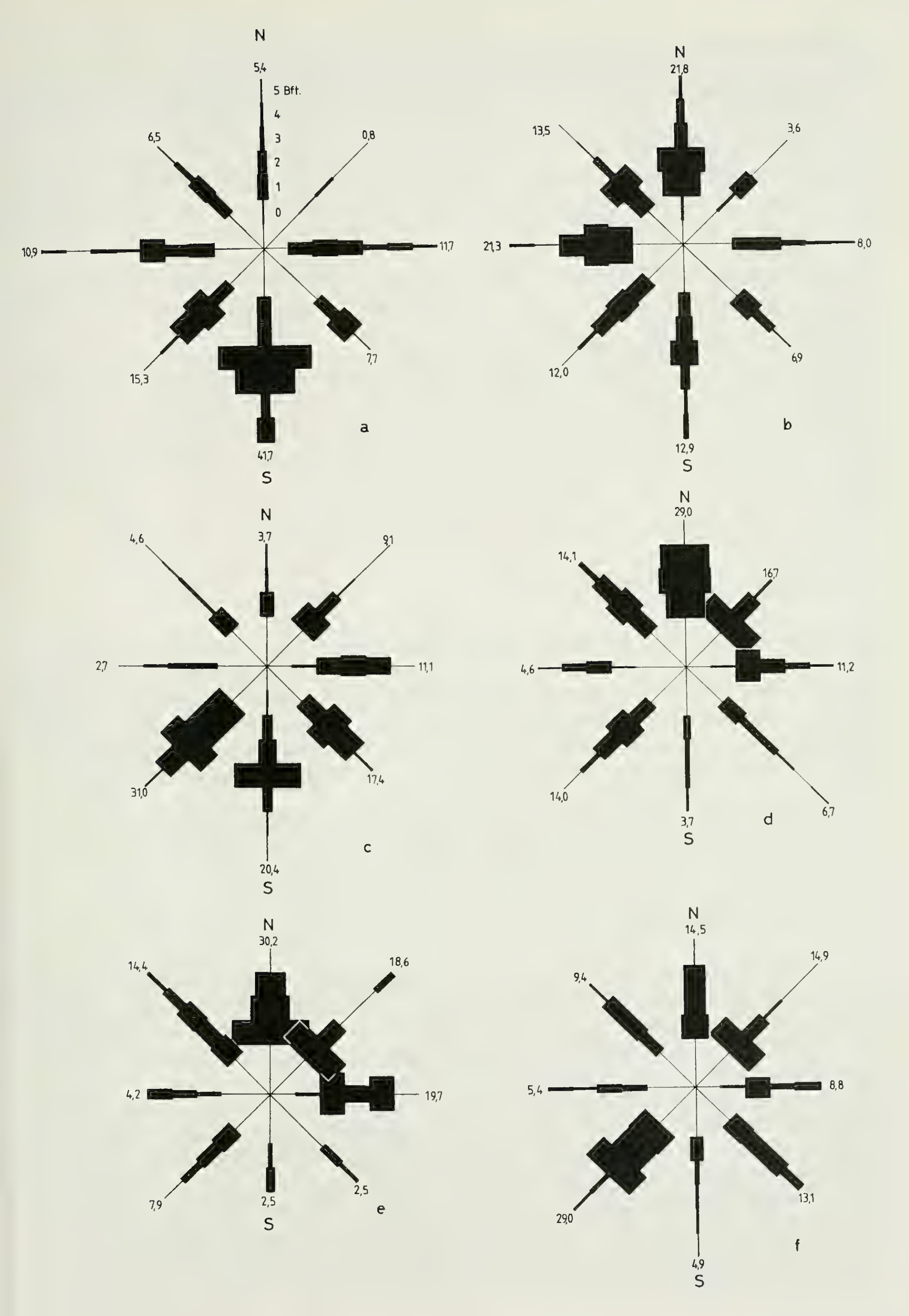

N
5,4
5 Bft.
4
3
2
1
0
6,5
0,8
10,9
11,7
15,3
7,7
41,7
S
a
N
21,8
13,5
3,6
21,3
8,0
12,0
6,9
12,9
S
b
N
3,7
4,6
9,1
2,7
11,1
31,0
17,4
20,4
S
c
N
29,0
14,1
16,7
4,6
11,2
14,0
3,7
S
6,7
d
N
30,2
14,4
18,6
4,2
19,7
7,9
2,5
2,5
S
e
N
14,5
9,4
14,9
5,4
8,8
29,0
13,1
4,9
S
f

Tabelle 4: Stündliche Fangsummen (S-Reuse) von *Episyrphus balteatus* an drei ausgewählten Tagen mit drehendem Wind.
Tab. 4: Catches per hour of *Episyrphus balteatus* in the S-trap (trap with opening to the north) at three selected days with shifting winds.

1.8.1982														
Uhrzeit	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Wind	SW	SW	SW	SW	W	W	N	N	N	N	N	N	N	N
Stärke	1	1	1	1	1	1	1	3	3	2	3	2	3	2
balt.	3	22	130	10	30	42	6	–	1	2	1	–	–	–
22.8.1984														
Uhrzeit	5	6	7	8	9	10	11	12	13	14	15			
Wind	S	SE	SE	S	SE	S	S	N	N	N	N			
Stärke	1	2	1	2	2	1	1	1	1	2	1			
balt.	3	3	4	70	84	126	43	22	4	7	8			
14.8.1985														
Uhrzeit	5	6	7	8	9	10	11	12	13	14	15	16		
Wind	S	S	S	S	SW	NW	N	N	S	S	SE	SE		
Stärke	2	2	2	2	1	2	2	1	2	1	2	2		
balt.	4	93	275	354	169	37	10	9	25	12	12	16		

3.4.3 *Episyrphus balteatus* 1981

Abb. 24c gleicht im wesentlichen Abb. 24a: ein großer Teil der Fliegen wird in der S-Reuse bei Gegenwinden mäßiger Stärke gefangen. Auch in die N-Reuse geraten die meisten Tiere gegen den Wind (Abb. 24e). Auch hier handelt es sich also keineswegs um einen Verdriftungseffekt. Eher ist denkbar, daß sich im Augenblick nicht wandernde *balteatus* gegen den Wind orientieren, um einer Verdriftung entgegenzuwirken; zum anderen muß berücksichtigt werden, daß hochsteigende Syrphiden sich gegen den Wind wenden, um danach ihre Wanderung mit dem Wind fortzusetzen (vgl. 3.4.6.1; Gatter 1981a).

In die N-Reuse fliegt *balteatus* überwiegend bei ganz schwachen Winden, während sich die Art in der S-Reuse in größerer Zahl bei etwas stärkeren Winden fängt (Abb. 25a, 25b).

3.4.4 *Platycheirus clypeatus* 1981

Abb. 24d bestätigt die an Abb. 24b gewonnenen Ergebnisse: *clypeatus* wird überwiegend bei Rükkenwinden aus NW, N oder NE (59,8 %) und nur in bedeutend geringerer Zahl bei Gegenwinden aus SW, S oder SE (24,4 %) in der S-Reuse gefangen. Auch in der N-Reuse fangen sich mehr *clypeatus* mit dem Wind (47,0 %) als gegen ihn (38,8 %) (Abb. 24f). Damit wird deutlich, daß *clypeatus* im bodennahen Bereich in erheblichem Ausmaß mit dem Wind wandert.

Dabei könnte die Möglichkeit bestehen, für eine bevorzugte Migrationsrichtung günstige Winde zu wählen und sich von ihnen „gezielt" verdriften zu lassen. In die N-Reuse flogen nur 47,0 % der dort gefangenen *clypeatus* mit Rückenwinden aus SW, S oder SE, während 59,8 % mit Rückenwinden aus NW, N oder NE in die S-Reuse gerieten (Abb. 24d, 24f). Nicht zuletzt angesichts der Tatsache, daß SW die häufigste Windrichtung ist, könnte dieses Zahlenverhältnis Ausdruck einer gezielten Auswahl in südliche Richtungen führender Windrichtungen sein. Dafür könnte auch die Relation der Fangzahlen mit der, allerdings nur wenig auffälligen, Überzahl der S-Flieger sprechen (S-Reuse : N-Reuse = 1,7:1; n = 5964). Allerdings fand die einzige andernorts beobachtete zahlenreiche Wanderung von

P. clypeatus bei starkem Südwind statt, so daß die Insekten nach Norden verdriftet wurden (Schmid 1987). Die Frage, ob die Dismigrationen von *clypeatus* zu einer gleichmäßigen Streuung im Raum führen oder durch Wahl bestimmter Windrichtungen gerichtete Komponenten enthalten (vgl. 4.5.4; Abb. 28), muß vorläufig offen bleiben (siehe dazu Gatter 1981 c).

Die Flugaktivität von *P. clypeatus* beschränkt sich am RM weitgehend auf relativ windarme Zeiten mit Windstärken zwischen 1 und 3 Bft. Zwischen den beiden Reusen ist kein Unterschied zu erkennen (Abb. 25a, 25c).

3.4.5 Das tageszeitliche Windangebot und seine Auswirkungen auf die Wanderaktivität von *Episyrphus balteatus* und *Platycheirus clypeatus*

Insekten wandern bevorzugt bei Hochdruck-(= Strahlungs-)wetter. Bei solchen Wetterlagen ist am Randecker Maar (und nicht nur dort) eine typische tageszeitliche Drehung der dann im allgemeinen nur schwachen bis mäßigen Winde festzustellen (Gatter 1981a, 1981b mit zahlreichen Einzelheiten). Wie auch in Tab. 4 (3.4.1) deutlich zu erkennen ist, herrschen in den Morgenstunden Winde aus südlichen Richtungen vor. Um die Mittagszeit dreht der Wind über West und bläst nun aus nördlichen Richtungen.

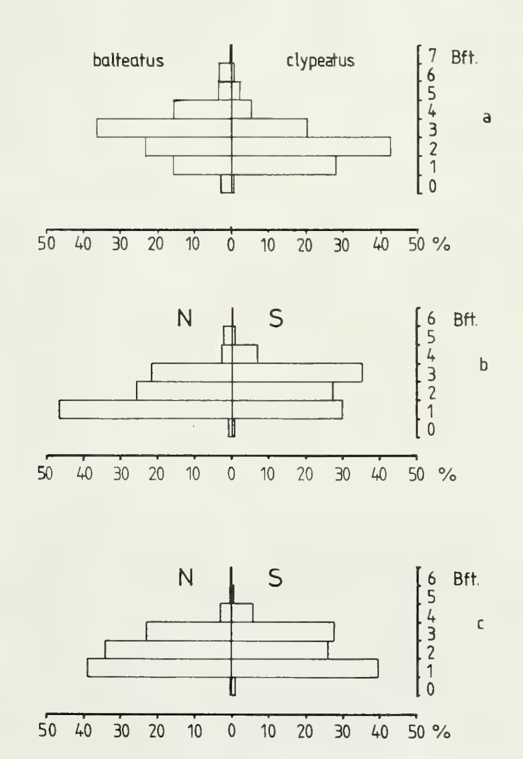


Abb. 25: Windstärken bei Flugbewegungen von *Episyrphus balteatus* und *Platycheirus clypeatus*.
Fig. 25: Wind forces during migration of *Episyrphus balteatus* and *Platycheirus clypeatus*.
a) Beide Arten/both species, 1986, S-Reuse/S-trap, n (*balteatus*) = 2937, n (*clypeatus*) = 3485
b) *E. balteatus*, 1981, S-Reuse/S-trap (n = 4244) und N-Reuse/N-trap (n = 355)
c) *P. clypeatus*, 1981, S-Reuse/S-trap (n = 1528) und N-Reuse/N-trap (n = 987)

Für *Episyrphus balteatus* bedeutet das, daß die Art vormittags niedrig und nachmittags in höheren Luftschichten zieht. Damit wird deutlich, daß der bei dieser Art besonders ausgeprägte Vormittagsgipfel (Abb. 15e, 15h) in der täglichen Verteilung **nicht** auf eine weitgehende Beschränkung der Zugaktivität auf die Vormittagsstunden zurückgehen muß, sondern vermutlich nur eine Folge der täglichen Winddrehung ist: vormittags herrscht gewöhnlich Gegenwind und die niedrig ziehenden Fliegen geraten in die Reuse, nachmittags überfliegen die mit Rückenwind ziehenden Insekten die Fangeinrichtung. Diese Strategie, mit den wechselnden Windrichtungen die Zughöhe zu ändern, ist wahrscheinlich einer der bedeutenden Grundpfeiler zur Ermöglichung transkontinentaler Insektenwanderungen (Gatter 1981a: 40ff, 1981b, Gatter & Gatter 1990).

Anders sind die Verhältnisse bei *Platycheirus clypeatus.* Diese Art weist im tageszeitlichen Verlauf einen ausgeprägten Nachmittagsgipfel auf (Abb. 5e, 5h). Auch hierfür könnte das tageszeitlich wechselnde Windangebot verantwortlich sein. Während der Vormittagsstunden, an denen meist schwache Winde aus südlichen Richtungen wehen, werden weniger *clypeatus* gefangen. Nachmittags fördern leichte nördliche Winde die Südwanderung dieses Dismigranten und steigern damit auch die Fangzahlen.

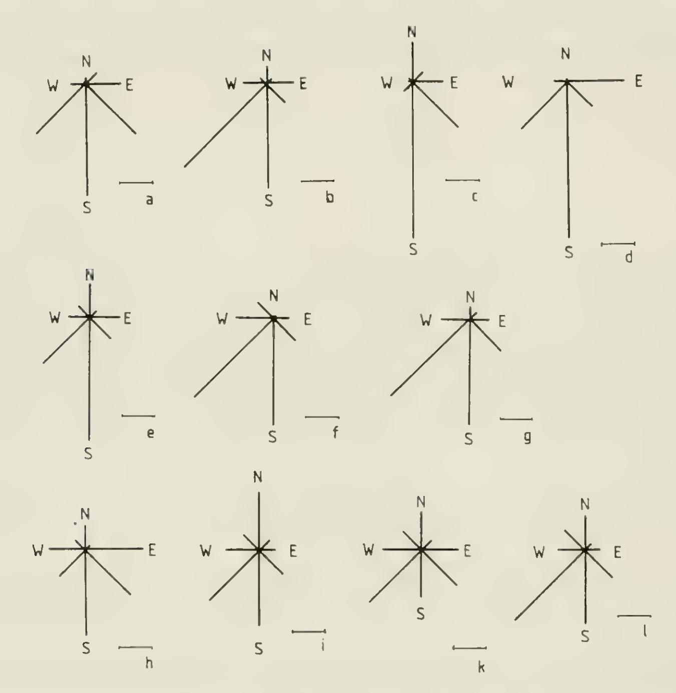


Abb. 26: Windrichtungen an Hauptzugtagen. Für alle Individuen einer Art (= 100 %) sind die Windrichtungen an den jeweils vier individuenstärksten Tagen jeden Jahres dargestellt. An der Länge der Linien ist ablesbar, wieviele Individuen der Art bei welcher Windrichtung in der S-Reuse gefangen wurden. Der Maßstab rechts unten entspricht 10 %.

Fig. 26: Wind direction at the four main days of migration in each year. The length of each of the eight lines is correlated with the number of individuals of the species which were caught in the S-trap (trap with opening to the north) with the wind blowing from the direction to which the line points. Scale below on the right: 10 %.

a) *Syrphus* spec., n = 2013
b) *Metasyrphus corollae,* n = 3869
c) *Scaeva pyrastri,* n = 209
d) *Episyrphus balteatus,* n = 13666
e) *Sphaeropharia scripta,* n = 4420
f) *Eristalis tenax,* n = 317
g) *Helophilus trivittatus,* n = 102
h) *Platycheirus albimanus,* n = 418
i) *Platycheirus clypeatus,* n = 4612
k) *Platycheirus manicatus,* n = 322
l) *Melanostoma mellinum,* n = 4342

3.4.6 Zusammenfassung: Windabhängige Wanderstrategien Saisonaler Migranten und Saisonaler Dismigranten

3.4.6.1 Saisonale Migranten

Die exemplarisch am Beispiel *Episyrphus balteatus* dargestellte Strategie der Nutzung günstiger und Vermeidung ungünstiger Winde läßt sich auch bei anderen Saisonalen Migranten beobachten. Wie *balteatus* wurden auch *Syrphus* spec., *Metasyrphus corollae, Scaeva pyrastri, Sphaerophoria scripta, Eristalis tenax, Helophilus pendulus* und *H. trivittatus* zu einem sehr deutlich überwiegenden Teil bei Gegenwinden gefangen (Abb. 26a–g).

Diese am RM gewonnenen Ergebnisse lassen sich auf andere Orte und Situationen übertragen. Typisch ist z. B. die Bemerkung bei Snow & Ross (1952), die in den Pyrenäen südwärts gerichteten Insektenzug beobachteten: „Syrphids were not noticed until the wind got up. From then on they crossed in increasing numbers, flying at 0 to 2 feet." Nachdem vorher Windstille geherrscht hatte, hatte ein langsam immer stärker werdender Südwind eingesetzt. Die Schwebfliegenwanderungen verlagerten sich deshalb in Bodennähe. Auch in den Alpen werden Massenwanderungen immer bei (oft föhnartig starken) Gegenwinden auffällig (z. B. Burmann 1978, Gepp 1975, Harz 1965, Jeekel & Overbeek 1968, Prell 1925). Nur dann fliegen die Syrphiden in Massen in Bodennähe und stauen sich an Pässen. Eindrucksvoll ist z. B. die Schilderung von einer Migration über den Weit-Riß-Paß (2350 m) bei Prell (1925), die sich v. a. auf *Eristalis tenax*, aber auch auf *Episyrphus balteatus* bezieht: „Ununterbrochen kamen in geradem Flug aus der Richtung des Melchtales Insekten herangezogen, welche deutlich gegen den von Süden her wehenden Föhn ankämpfend über den Grat hinwegzukommen versuchten. Handhoch bis meterhoch über die Felskante hinwegstreichend, die höchsten etwa mannshoch fliegend, kamen die Tiere scharenweise heran. Deutlich konnte man sehen, daß manche sich bemühten, den Windschatten hinter dem Grat auszunutzen und dann unter Anspannung aller Kraft den Grat selbst zu überwinden. ... Nicht ein einziges Tier wurde während der ganzen Zeit in entgegengesetzter Richtung fliegen gesehen."

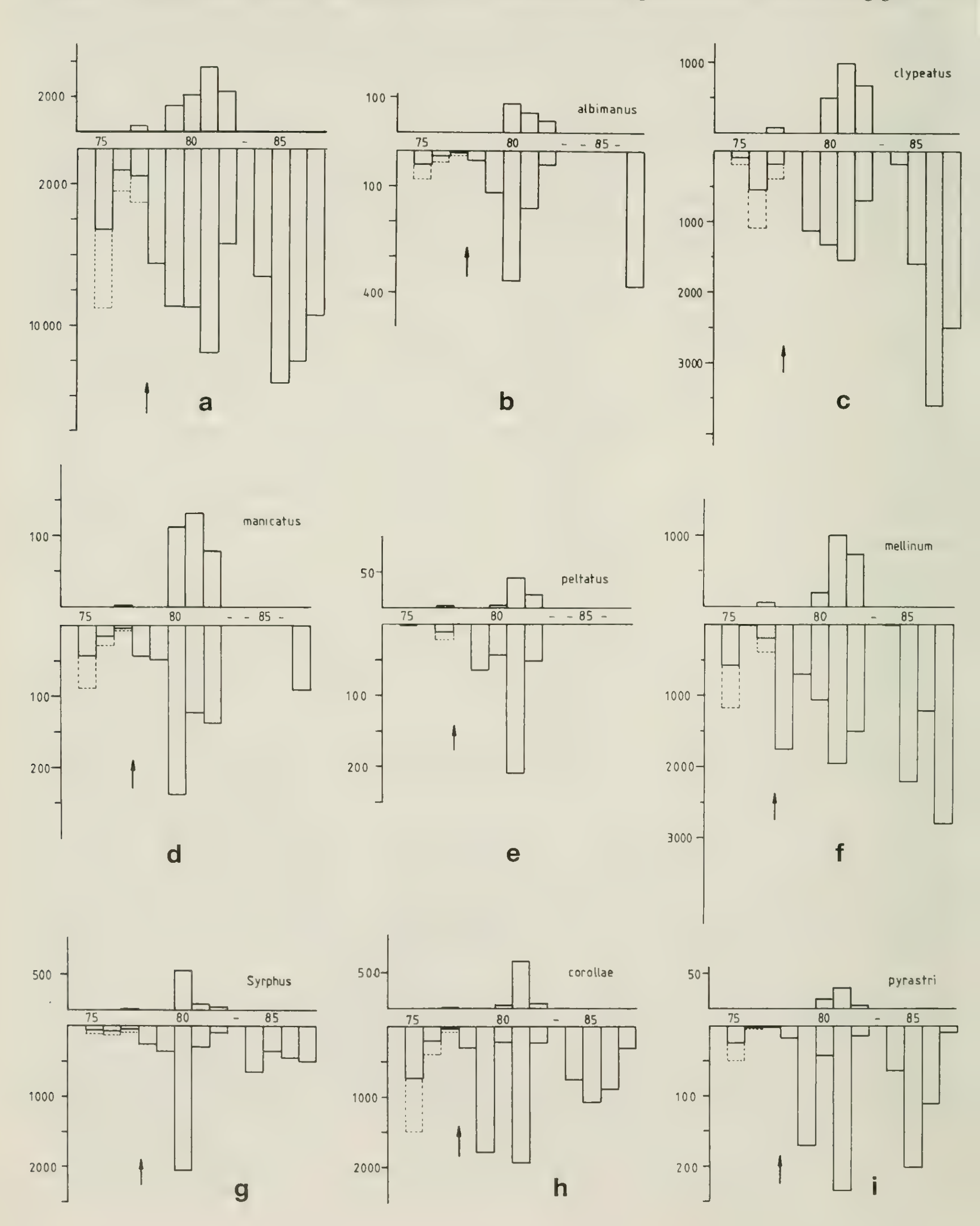
Nicht nur im Gebirge, sondern auch an Küsten wurden große Schwebfliegenkonzentrationen v. a. bei Gegenwinden beobachtet (z. B. Mackworth-Praed 1929, Svensson & Janzon 1984).

Wie Syrphiden die in größerer Höhe stärkeren Rückenwind nutzen, hat Gatter (1981a: 51) anschaulich geschildert: „Große Arten der Gattung *Eristalis, Scaeva* usw. können mit einem normalen Fernglas etwa 200 m weit verfolgt werden. Dabei zeigt sich, daß das Hochsteigen bei Rückenwinden auch hier durch Drehung gegen den Wind geschieht. Die Fliegen, die mit Rückenwinden im bodennahen Bereich Geschwindigkeiten von 40 bis 56 Stundenkilometern erreichen können, drehen sich in einem weiten Bogen gegen den Wind, werden dabei ca. 10 bis 30 m hochgerissen und fliegen dann mit dem Wind weiter. Am 20.9.1980, einem sehr heißen Sommertag mit günstigem Nordostwind um 15 km/h, verließen die wenigen ziehenden Tiere, die in Bodennähe flogen, fast alle auf diese Weise die tiefere untere Zone. In 1200 bis 1500 m über Grund (ca. 2000 m NN) herrschte dagegen reges Zuggeschehen wohl eben dieser Arten nach Südwest. Bei einer Eigengeschwindigkeit von 25 km/h und einer Windgeschwindigkeit von 17 km aus Nordost zogen die Fliegen mit ca. 40 km/h ... Das Hochsteigen hat hier wohl auch den Zweck, eine drohende Überhitzung zu vermeiden. In 2000 m lag die Nachmittagstemperatur an diesem Tag bei 12,8° (...). Die Schwebfliegen fanden hier stoffwechselphysiologisch günstigere Bedingungen zur Migration vor als im 28° warmen Tiefland."

Insektenzug in großer Höhe ist natürlich nicht leicht zu beobachten. Gute Indikatoren sind in solchen Höhen jagende Vogelschwärme (vgl. Gatter 1981a: 53f., Spreadbury 1960). Glick (1939, 1942, 1960) und Glick & Noble (1961) (zitiert in Johnson 1969) fingen mit Hilfe von Flugzeugen Schwebfliegen in Höhen bis zu 5000 Fuß.

3.4.6.2 Saisonale Dismigranten

Bei den Dismigranten wie *Platycheirus clypeatus, P. albimanus, P. manicatus* oder *Melanostoma mellinum* ist die Streuung der Windrichtungen beim Fang in der S-Reuse größer als bei den Saisonalen Migranten (Abb. 26h–l). Häufiger als diese geraten die Dismigranten bei Rückenwinden in die S-Reuse – ein Hinweis darauf, daß die oben für Saisonwanderer geschilderte, windabhängige Wahl



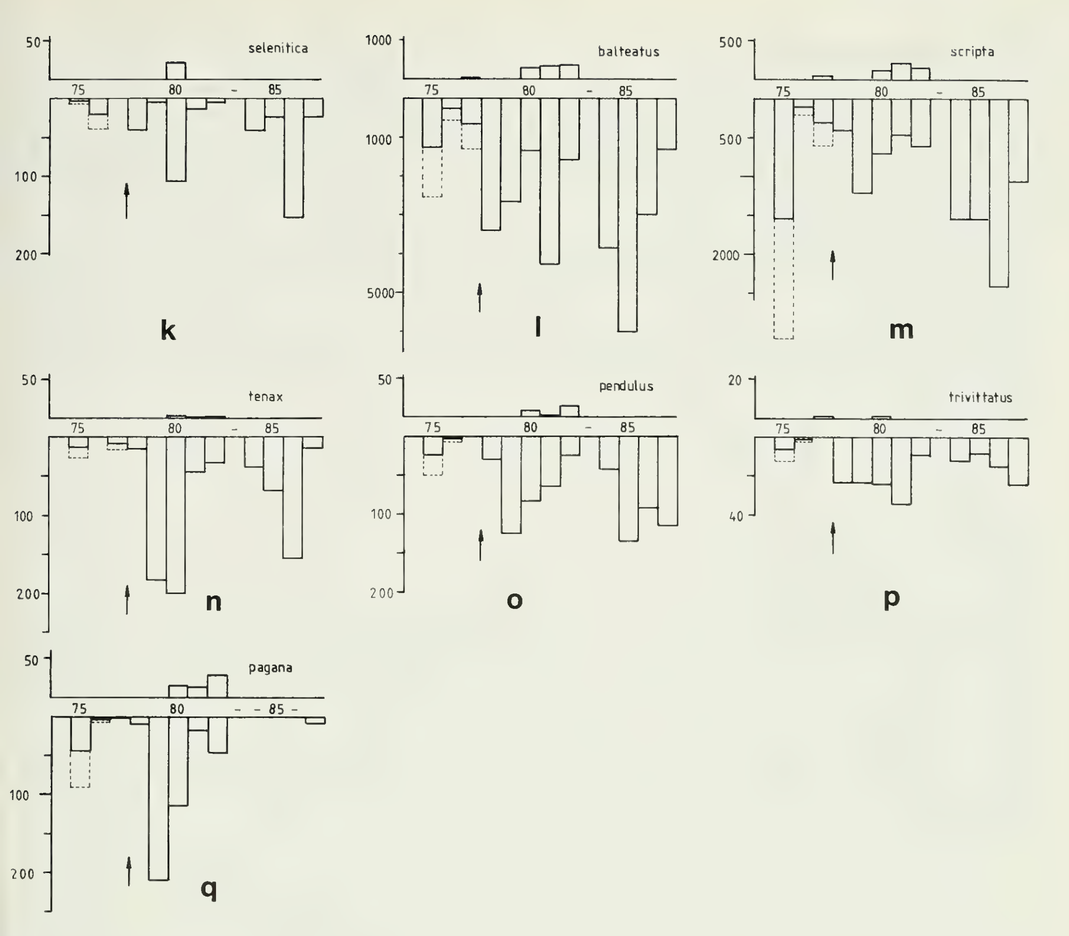


Abb. 27: Fangsummen in der S-Reuse (unten) und der N-Reuse (oben) in den Jahren 1975–1987. Der Pfeil gibt den Zeitpunkt der Verdoppelung der Größe der S-Reuse an (1978). Zur besseren Vergleichbarkeit sind die verdoppelten Fangzahlen der Jahre 1975–1977 gebrochen dazugezeichnet. Jahre ohne Erfassung der jeweiligen Art sind in der Zeitspalte mit — gekennzeichnet.

Fig. 27: Numbers of Syrphidae caught in the S-trap (trap with opening to the north; below) and the N-trap (opening to the south; above) in 1975–1987. The arrow indicates the date when the S-trap size was doubled (1978). For better comparison, the diagram shows double numbers of 1975–1977 in broken lines. Years without identification of the respective species are marked with – .

a) Syrphidae insgesamt/total
b) *Platycheirus albimanus*
c) *Platycheirus clypeatus*
d) *Platycheirus manicatus*
e) *Platycheirus peltatus*
f) *Melanostoma mellinum*
g) *Syrphus* spec.
h) *Metasyrphus corollae*
i) *Scaeva pyrastri*
k) *Scaeva selenitica*
l) *Episyrphus balteatus*
m) *Sphaerophoria scripta*
n) *Eristalis tenax*
o) *Helophilus pendulus*
p) *Helophilus trivittatus*
q) *Cheilosia pagana*

der Zughöhen von Dismigranten nicht im selben Ausmaß durchgeführt wird. Dismigranten wandern zwar hauptsächlich mit dem Wind. Die trotz allem hohen Zahlen der bei Gegenwinden gefangenen Fliegen lassen aber ebenso wie die bei allen Arten zu beobachtenden zahlenstärkeren Fänge in der S-Reuse vermuten, daß auch sie im Herbst eine Tendenz haben, in südliche Richtungen zu wandern und dabei auch Gegenwindbewegungen durchführen können (vgl. 4.5.4). Diese Frage bedarf weiterer Klärung.

3.5 Populationsdynamik

Tab. 1 und Abb. 27a zeigen die relativ starken Schwankungen der jährlichen Fangzahlen am RM. Noch extremer sind die Häufigkeitsunterschiede von Jahr zu Jahr bei einzelnen Arten (Abb. 27b–q). Ähnlich stark wie am RM sind diese Schwankungen am CB (Aubert et al. 1976). Sie sind auch überall im Freiland zu beobachten.

Die Zahl der Jahr für Jahr in den Reusen gefangenen Insekten wird natürlich von sehr vielen Faktoren beeinflußt. Wichtig ist mit Sicherheit der konkrete Witterungsverlauf während einer Fangperiode. Allerdings ist das Wetter nicht direkt und allein für die schwankenden Fangzahlen verantwortlich. Wie der unterschiedliche Verlauf der Kurven einzelner Arten zeigt (s. u.), spiegeln die Diagramme auch die tatsächliche Häufigkeit der einzelnen Arten in den betreffenden Jahren wider.

Ausschlaggebend für den Populationsaufbau bei aphidophagen Formen – und dazu gehören fast alle Saisonalen Migranten unter den Schwebfliegen (vgl. Tab. 3) – ist in erster Linie das Blattlausangebot im Frühjahr und Frühsommer. Die Diagramme für die aphidophagen Saisonwanderer *Syrphus* spec., *Metasyrphus corollae, Scaeva pyrastri, S. selenitica, Episyrphus balteatus* und *Sphaerophoria scripta* zeigen allerdings keinen einheitlichen Verlauf: im Jahr 1980 erschienen z. B. nur wenige *balteatus, corollae, pyrastri* und *scripta,* während *Syrphus* spec. und *Scaeva selenitica* ausgesprochene Maxima aufwiesen. Auch die Saisonalen Dismigranten *Platycheirus albimanus, P. manicatus* und *P. peltatus* zeigen ausgeprägte Höhepunkte. Alle genannten Arten sind im Larvenstadium Blattlausfresser mit weitem Beutespektrum, die auch weitgehend dieselben Habitate besiedeln (vgl. 3.1; Rotheray & Gilbert 1989). Die Zahlen lassen vermuten, daß sich ihre Populationen gegenseitig über (Nahrungs-) Konkurrenz beeinflussen. Nachgewiesen ist, daß *Syrphus ribesii* Blattlauskolonien effektiver nutzt als *Melanostoma scalare* (Rotheray 1983) und daß die Mortalität der Larven von *Metasyrphus corollae* bei der Anwesenheit von *ribesii*-Larven steigt (Benestad Hågvar 1972).

Auch aquatische Formen können starke Schwankungen aufweisen (Abb. 27n–p). Ihre Diagramme lassen jedoch keine gegenseitige Beeinflussung erkennen.

4. Diskussion

4.1 Vergleich der Phänologie der Schwebfliegenwanderungen am Randecker Maar und am Col de Bretolet

Bei zahlreichen Arten ist, wie in den Artabschnitten jeweils kurz erwähnt (vgl. 3.1), der Zughöhepunkt am Col de Bretolet deutlich später als am Randecker Maar. Besonders klar ist dieser Unterschied bei *Episyrphus balteatus* (Abb. 15a): An beiden Stationen steigen die Fangzahlen in der zweiten Julihälfte stark an. Während der Durchzug am RM aber nach einem ausgeprägten Höhepunkt Anfang August in der zweiten Monatshälfte so stark abflaut, daß im September nur noch wenige *balteatus* (ca. 5 % der Gesamtsumme) gezählt werden, ist am CB nach dem ebenfalls in der ersten Augusthälfte erreichten Maximum bis Mitte Oktober starker Durchzug festzustellen. Der Median, am RM der 7. 8., ist also am CB weit nach hinten verschoben. Auch im Geschlechterverhältnis besteht ein gravierender Unterschied: am RM sind ♂♂ und ♀♀ gleich stark vertreten, am CB werden fast ausschließlich ♀♀ gefangen (vgl. 4.2).

Der Col de Bretolet liegt ca. 350 km südwestlich des Randecker Maars. Für den Brachpieper, einen Zugvogel, dessen Winterquartiere südlich der Sahara liegen, errechnete Gatter (1970) eine Verschiebung des Herbstzugsmedians von zehn Tagen zwischen Kirchheim (am RM) und dem Col de Bretolet und damit eine tägliche Vorrückstrecke von ca. 35 km. Eine solche Tagesetappe ist auch für Schwebfliegen mit Sicherheit gut zu bewältigen: trotz ungünstiger Wetterbedingungen fingen Aubert et al. (1969) am Col du Glandon Schwebfliegen, die sie drei Tage zuvor am 111 km entfernten Col de Bre-

tolet markiert hatten. Die Medianverschiebung zwischen RM und CB dürfte bei Syrphiden genau wie beim Brachpieper eine Folge der Lagebeziehungen der beiden Stationen sein: die in Zugrichtung nachgeschaltete Beobachtungsstation am CB wird von der Hauptmasse der Durchzügler später erreicht. Auch das Ende der Zugperiode wird von der Lage natürlich beeinflußt. Beim Brachpieper wie bei *Episyrphus balteatus* endet die Zugzeit am CB wesentlich später als am RM.

Ähnlich deutlich wie bei *balteatus* ist die Verschiebung der Maxima und Verlängerung der Flugzeit bei den Saisonalen Migranten *Metasyrphus corollae* (S. 35), *Meliscaeva cinctella* (S. 43), *Eristalis tenax* (S. 61) und *Helophilus trivittatus* (S. 66) und bei dem Saisonalen Dismigranten (?) *Platycheirus manicatus* (S. 26).

Mehrere Arten zeigen zwar eine Verlängerung der Flugzeit, aber keine Verschiebung des Maximums (bzw. sind am CB keine deutlichen Maxima ausgeprägt), so die Saisonalen Migranten *Syrphus* spec. (S. 33), *Scaeva pyrastri* (S. 38) und *S. selenitica* (S. 41) und der Saisonale Dismigrant *Melanostoma mellinum* (S. 29) sowie der Saisonale Dismigrant (?) *Parasyrphus lineolus* (S. 42).

Weitgehende Entsprechung der Phänologie beider Orte weist der Saisonale Migrant *Sphaerophoria scripta* (S. 52) auf; das könnte auf kürzere Migrationsentfernungen schließen lassen.

4.2 Veränderungen der Zahlenverhältnisse der Geschlechter im Verlauf der Migration

Balteatus-♂♂ haben eine wesentlich geringere Lebenserwartung als ♀♀. „Am 49. Gesamtlebenstag (d. h. ca. 4 Wochen nach dem Schlupftermin) waren bereits 50 % der ♂♂ tot ... Die Hälfte der ♀♀ wurde 60 Tage alt. Dieses Alter erreichten nur ca. 25 % der ♂♂, während von den ♀♀ 25 % (13 von 52 Individuen) ein Alter von 80 Tagen und 9 Individuen sogar ein Alter von über 100 Tagen erlangten. Eine deutlich erhöhte Sterblichkeit führte bei den ♂♂ schon ab dem 55. Gesamtlebenstag zu einer raschen Abnahme der Zahl der Überlebenden. Die durchschnittliche Lebensdauer ... war für die ♀♀ mit 39,5 Tagen ebenfalls deutlich höher als die der ♂♂ mit 23,5 Tagen" (Geusen-Pfister [1987] nach Versuchen unter Gewächshausbedingungen). Dadurch erklärt sich die Beteiligung beider Geschlechter von *balteatus* an den Fängen im RM (wie übrigens auch an den norddeutschen Feuerschif-

Tabelle 5: Geschlechter-Verhältnis von Wanderschwebfliegen an Feuerschiffen der Nord- und Ostsee (nach Heydemann 1967), am Randecker Maar und am Col de Bretolet (nach Aubert 1962).
Tab. 5: Sex ratios of migratory hoverflies at lightships in the North Sea and the Baltic Sea, at Randecker Maar and at Col de Bretolet.

Art	Feuerschiffe		Randecker Maar		Col de Bretolet	
	♂♂:♀♀	(n)	♂♂:♀♀	(n)	♂♂:♀♀	(n)
P. albimanus	1:0,96	(165)	1:2,82	(833)	1:20,25	(85)
P. manicatus	1:0,44	(13)	1:1,18	(550)	1:0,11	(40)
M. mellinum	1:0,10	(34)	1:3,58	(11524)	1:2,34	(1535)
S. ribesii	1:2,00	(36)			1:8,00	(9)
S. torvus			1:1,86	(4030)	16 ♀♀	(16)
S. vitripennis	1:1,33	(7)			68 ♀♀	(68)
*M. corollae**	1:1,87	(526)	1:1,07	(7545)	1:3,72	(142)
M. luniger					1:16,00	(17)
M. auricollis					1:61,00	(62)
E. balteatus	1:0,99	(507)	1:0,92	(27135)	1:14,09	(1569)
S. scripta			1:1,71	(11204)	1:3,98	(209)
E. tenax			1:1,32	(511)	1:1,34	(1230)

* In Südschweden Anfang August 1:1,6 (n = 4338) (Svensson & Janzon 1984).

fen [Heydemann 1967]) und das weitgehende Fehlen der ♂♂ am CB. Der CB mit seinem wesentlich später liegenden Durchzugsmedian wird von ♂♂ kaum mehr erreicht. Die meisten ♂♂ sterben vorher. – (Leider liegen vom CB nur wenige Stichproben zum Geschlechterverhältnis vor [Aubert 1962], ohne daß eine genaue zeitliche Zuordnung der Daten möglich ist. Zu erwarten wäre, daß ein zu Beginn der Zugzeit weitgehend ausgeglichenes Verhältnis sich schnell zugunsten der ♀♀ verschiebt. Am RM wird jedenfalls deutlich, daß *balteatus*-♂♂ im September praktisch nicht mehr vertreten sind [vgl. Abb. 15b].)

Die Verschiebung des Geschlechter-Verhältnisses ist wie die Medianverschiebung zwischen RM und CB ein Beleg dafür, daß sich eine Zugwelle wenigstens über das südliche Nord- und über Mitteleuropa hinweg bewegt.

Für einige häufigere Arten liegen Daten zum Geschlechter-Verhältnis von mehreren Orten vor (Tab. 5).

Für die Saisonalen Wanderer *Syrphus* spec., *Metasyrphus corollae, Episyrphus balteatus* und *Sphaerophoria scripta* zeigt sich zwischen RM und CB durchgehend eine Verschiebung des Verhältnisses zugunsten der Weibchen. Für alle diese Arten ist, wie oben für *balteatus* geschildert, anzunehmen, daß im Verlauf einer großräumigen Migration die ♂♂ absterben. Das gilt auch für *E. tenax*, selbst wenn hier als Folge der sehr späten Flugzeit das Geschlechterverhältnis zwischen RM und CB keine Unterschiede aufweist. Auch bei dieser Art dominieren zu Beginn der Zugzeit am CB im August und Anfang September die ♂♂, später die ♀♀ (Aubert 1962); wie bei den anderen Saisonalen Migranten werden also auch hier die ♂♂ im Herbst seltener. Die Daten für die am RM seltenen Saisonwanderer *Meliscaeva auricollis* und *Metasyrphus luniger* zeigen mit ihrem extremen ♀♀-Überschuß am CB, daß die Verhältnisse denen von *E. balteatus* wohl weitgehend entsprechen.

Während die aus Farbschalenfängen von norddeutschen Feuerschiffen (Juli/August) gewonnenen Angaben im wesentlichen den Daten vom RM entsprechen, ließen sich die am CB beobachteten Zahlenverhältnisse auch andernorts in den Alpen bestätigen. Jeekel & Overbeek (1968) beobachteten am 9.8.1967 in Tirol für die Saisonalen Migranten *Episyrphus balteatus, Sphaerophoria scripta, Syrphus torvus* und *S. vitripennis* eine starke Dominanz der ♀♀. Auch die von Burmann (1978) ebenfalls aus Nordtirol mitgeteilten Daten lassen ein starkes Überwiegen der ♀♀ bei *Episyrphus balteatus, Syrphus ribesii, Metasyrphus corollae* und *Sphaerophoria scripta* erkennen.

Demnach sind die oben für *Episyrphus balteatus* dargestellten Verhältnisse wohl für die ganze Gruppe der Saisonalen Migranten unter den Schwebfliegen gültig.

Unter der Gruppe der Dismigranten *(Platycheirus albimanus, P. manicatus* und *Melanostoma mellinum)* sind die Verhältnisse weit weniger klar. Die Daten lassen aufgrund des geringen Umfanges der meisten von anderen Orten vorliegenden Stichproben auch kaum weitergehende Deutungen zu. Mit Sicherheit besteht aber der für die Saisonalen Migranten typische, auf weitreichende Wanderungen hinweisende Unterschied zwischen dem Geschlechterverhältnis an den einzelnen Beobachtungsstationen nicht. Der häufig zu beobachtende ♀♀-Überschuß geht auf die höhere Dismigrationsbereitschaft der ♀♀ zurück.

4.3 Biologie der Wanderschwebfliegen

Aus Tab. 3 (vgl. 3.3) wird zweierlei deutlich: (1) alle Saisonmigranten sind entweder aphidophag oder aquatisch sapro-/microphag (vgl. Schmid & Gatter 1988). Unter den anderen trophischen Gruppen findet sich keine Art, die saisonale Migrationen durchführt und (2) **sämtliche** Schwebfliegenarten, die nicht als Larve, sondern als Imago überwintern, gehören zur Gruppe der Saisonalen Migranten, ebenso die als Puparium überwinternden polyvoltinen Arten. Diese beiden Ergebnisse werden im folgenden diskutiert.

4.3.1 Arten mit phytophagen und terrestrischen saprophagen Larven

Für eine Art wie beispielsweise *Cheilosia fasciata* Schiner & Egger 1853, deren Larven als Nahrungsspezialisten in Blättern des Bärlauchs *(Allium ursinum)* minieren, ist der Vorteil, **nicht** in größerem Ausmaß zu wandern, deutlich: die Nahrungsquelle steht mit Sicherheit im nächsten Jahr am selben Ort wieder zur Verfügung. Ähnlich spezialisiert sind, soweit bekannt, sehr viele phytophage Schwebfliegen z. B. der Gattungen *Cheilosia* (z. B. Smith 1979, Rotheray 1988), *Merodon* oder *Eumerus.* Die Überwinterung findet geschützt in der Erde statt. Damit wird plausibel, warum es unter den phytophagen Schwebfliegen keine Wanderarten gibt.

Ähnliches dürfte für die Gruppe der terrestrischen saprophagen Syrphiden gelten. Auch sie beuten eine Nahrungsressource aus, die im nächsten Jahr mit großer Wahrscheinlichkeit in der Nähe wieder verfügbar ist. Mit Sicherheit bewegen sich die meisten dieser Arten vom Geburtsort weg; die Distanzen sind aber fast immer sehr gering. Lediglich einige Arten der Gattung *Xylota* führen Saisonale Dismigrationen aus, die etwas weiter führen (Tab. 3).

4.3.2 Arten mit zoophagen Larven

Aphidophage Schwebfliegen stehen dagegen vor dem Problem, daß ihre Larven eine Nahrungsquelle benötigen, die in Raum und Zeit oft unvorhersagbar auftritt. Hier helfen in den Lebenszyklus integrierte Dismigrations- oder Migrationsphasen bei der Auffindung und Ausnutzung solcher Ressourcen.

Sehr viele aphidophage Schwebfliegen sind monovoltine Frühjahrsarten, die zudem oft mehr oder weniger spezialisiert sind. Ihre Flugzeit deckt sich mit dem Frühjahrsmaximum der Blattlausentwicklung (vgl. Dušek & Láska 1986). Für einige dieser Arten *(Parasyrphus)* konnte oben nachgewiesen werden, daß sie Dismigrationen durchführen. Es ist wahrscheinlich, daß sehr viel mehr dieser Arten dismigrieren. Durch ihre frühe Flugzeit entgehen sie aber der Erfassung sowohl am RM wie am CB.

Saisonale Dismigranten sind, neben diesen monovoltinen Frühjahrsarten, vor allem Arten der innerhalb der Zoophagen phylogenetisch ursprünglichen Gattungen (Rotheray & Gilbert 1989) *Platycheirus* und *Melanostoma.* Bei beiden Gruppen stehen Wanderungen nicht im Zusammenhang mit dem Aufsuchen von Winterquartieren, sondern dienen in erster Linie dem Auffinden von Eiablageplätzen. Bei den monovoltinen Frühjahrsarten erleichtert das Frühjahrsmaximum der Blattläuse diese Suche, bei *Platycheirus* und *Melanostoma* ihre weite ökologische Potenz. Fast alle Arten dieser beiden Gattungen ziehen zwar Blattläuse als Nahrung vor, sind aber auch sehr oft in der Bodenstreu zu finden, wo sie Jagd auf andere Arthropoden machen. Sie entgehen damit während des Sommerminimums der Blattläuse der Konkurrenz durch die aphidophagen, polyvoltinen Saisonwanderer. Rotheray (1983) konnte zeigen, daß *Syrphus ribesii* Blattlauskolonien effektiver nutzen kann als *Melanostoma scalare.*

Die Saisonalen Migranten unter den Aphidophagen sind alle polyvoltin und, was die Nahrung und das Habitat (vgl. Chandler 1968b, Láska & Starý 1980) betrifft, zwar spezialisierter als die meisten *Platycheirus*- und *Melanostoma*-Arten, aber gewöhnlich wesentlich weniger spezialisiert als die univoltinen Arten. Sie stellen während des sommerlichen Minimums der Blattlausentwicklung die Hauptmasse der Schwebfliegen (vgl. Dušek & Láska 1986). Ihre ausgeprägte Migrationsneigung kann (gemeinsam mit ihrem weiten Nahrungs- und Habitatspektrum) einerseits als Anpassung an die Notwendigkeit verstanden werden, die in dieser Jahreszeit nur spärlich vorhandenen Blattläuse aufzufinden, andererseits steht sie, zum mindesten bei den Formen, die den Winter als Puparien oder Imagines überdauern, in engem Zusammenhang mit der Überwinterung. Für *Episyrphus balteatus,* die am besten bekannte Art, wurde der adaptive Wert der spätsommerlichen und herbstlichen Wanderung in südliche Gebiete bereits diskutiert (S. 52). Es ist anzunehmen, daß das dort Gesagte auch auf die anderen Arten übertragen werden kann. Demnach ist einerseits im nördlichen Europa Überwinterung

nicht oder nur sehr eingeschränkt möglich; auch in Mitteleuropa ist das Überwinterungsrisiko für diese Arten beträchtlich, weshalb große Teile der Populationen im Herbst nach Süden ziehen. Andererseits finden die Larven (möglicherweise auch die Imagines) im Frühjahr und Sommer in Mitteleuropa bessere Entwicklungs- und Lebensbedingungen als in Südeuropa vor. Es bleibt zu prüfen, ob die Wanderungen auch für die den Winter als diapausierende Larven überstehenden Saisonwanderer *Syrphus* spec. und *Sphaerophoria scripta* einen ähnlichen adaptiven Wert besitzen.

Zusammenfassend (und vereinfachend) lassen sich also unter den zoophagen Schwebfliegen drei Migrationsstrategien erkennen:

- Unspezialisierte, zoophage, polyvoltine Arten, die Saisonale Dismigrationen ausführen, um geeignete Eiablageplätze aufzufinden: Arten der Gattungen *Platycheirus* und *Melanostoma.*
- Etwas stärker spezialisierte, aphidophage, polyvoltine Arten, die Saisonale Migrationen durchführen, um einerseits Nahrungs- und Eiablageplätze, andererseits günstige Überwinterungsplätze zu finden: Arten siehe Tab. 3.
- Spezialisierte, monovoltine Arten, die Dismigrationen durchführen, um geeignete Eiablageplätze aufzufinden: Arten der Gattung *Parasyrphus* und vermutlich noch viele weitere Species.

4.3.3 Arten mit aquatischen sapro-/microphagen Larven

Larvenhabitate dieser Gruppe sind Gewässer – vom offenen Teich bis zur wasserdurchtränkten mulmigen Baumhöhlung. Vor allem offene Kleingewässer können wetterabhängig leicht verschwinden; für manche Arten ist das Angebot an Larvenhabitaten somit vielfachen Schwankungen ausgesetzt.

Unter den Arten der aquatischen Gruppe sind verschiedene Strategien erkennbar. Sehr viele Species wandern nicht, so z. B. die häufige *Myathropa florea* (Linnaeus 1758), deren Larven in Kleinstgewässern zwischen Baumwurzeln o. ä. leben. Manche Arten wandern nur zu einem mehr oder weniger großen Teil, so *Eristalis arbustorum* und *E. pertinax.* Sie verfolgen also eine „Doppelstrategie", bei der der Schwerpunkt bei der Überwinterung von Larven im Heimatgebiet ist. Bei *Helophilus pendulus* und *H. trivittatus* ist die Wanderneigung dagegen sehr viel ausgeprägter. Für *pendulus* lassen die zahlreichen Beobachtungen im frühen Frühjahr vermuten, daß ein beträchtlicher Anteil als Larve in Mitteleuropa überwintert; bei *trivittatus* sind Frühjahrsbeobachtungen so spärlich, daß angenommen werden muß, daß der Aufbau mitteleuropäischer Populationen überwiegend auf Immigranten zurückgeht.

Die einzige Art dieser Gruppe, die als Imago überwintert, ist *Eristalis tenax.* Für das Überwinterungsrisiko in Mitteleuropa dürfte dasselbe gelten wie bei den aphidophagen, als Imagines überwinternden Schwebfliegen (4.3.2). Im Mittelmeergebiet überwinternde Tiere haben vermutlich wesentlich größere Überlebenschancen. Dagegen bietet im Sommer das humide Mitteleuropa den wasserlebenden *tenax*-Larven mit Sicherheit mehr und günstigere Entwicklungschancen als das trockene Südeuropa. – Vermutlich spielen beim Aufbau der Sommerpopulationen in Mittel- und Nordeuropa hier überwinternde *tenax*-♀♀ gegenüber den Immigranten in den meisten Jahren nur eine untergeordnete Rolle.

4.4 Zur Bedeutung der Wanderschwebfliegen bei der biologischen Schädlingsbekämpfung

Unter den aphidophagen Insekten kommen Marienkäfern (Coccinellidae), Florfliegen und Blattlauslöwen (Chrysopidae und Hemerobiidae) und Schwebfliegen besondere Bedeutung zu (Rotheray 1989). Nach Versuchen von Sundby (1966) hat dabei die Larve der Schwebfliege *Syrphus ribesii* eine größere Fraßleistung als die des Marienkäfers *Coccinella septempunctata* L. und die der Florfliege

Chrysoperla carnea St. Die hohe Nachkommenzahl der Florfliege läßt diese (im Labor) als den beiden anderen Arten weit überlegenen Blattlausvertilger erscheinen. Außerhalb des Labors ist es von vielen Faktoren abhängig (beteiligte Arten, Luftfeuchtigkeit, Temperatur etc.; vgl. Bastian 1986), welche der drei Insektengruppen als effektivster Prädator auftritt.

Unter den aphidophagen Schwebfliegen gibt es weitgehend spezialisierte Arten wie z. B. *Neocnemodon vitripennis* (Meigen 1822), eine hauptsächlich von Tannenstammläusen (v. a. *Dreyfusia piceae* Ratzeburg) lebende Art, die einen mit den Populationsmaxima der Beutetiere synchronisierten bivoltinen Lebenszyklus aufweist (Delucchi et al. 1957). Zahlreiche univoltine Frühjahrsarten unter den Schwebfliegen nutzen das Frühjahrs- und Frühsommermaximum der Laus-Populationen. Viele dieser Arten sind hauptsächlich in Wäldern anzutreffen (Arten der Gattungen *Dasysyrphus, Parasyrphus, Epistrophe).*

Die häufigsten aphidophagen Schwebfliegenlarven in einem von Bastian (1984) untersuchten Koniferenjungwuchs waren allerdings keine solchen „Waldarten", sondern typische Wanderschwebfliegen. Dazu gehörten die Saisonalen Migranten *Syrphus ribesii, S. torvus, S. vitripennis, Episyrphus balteatus* und *Sphaerophoria scripta* und der Saisonale Dismigrant *Melanostoma mellinum.* Bastian (1984) konnte zeigen, daß unter den Blattlausprädatoren Schwebfliegen in einem Jahr mit witterungsbedingt stark verzögertem Aufbau der Läusepopulationen am raschesten auf diese veränderte Situation reagierten.

Voraussetzung für diese Flexibilität ist einerseits die hohe Mobilität der Wanderschwebfliegen, andererseits ihr polyvoltiner Lebenszyklus und ihre geringe Spezialisierung auf bestimmte Beutetiere. Die polyvoltinen Arten sind nicht an eng begrenzte Fortpflanzungszeiten gebunden; sie nutzen Blattlauskolonien auch im Sommer, wenn die Populationshöhe und Fortpflanzungsrate der Läuse einen Tiefpunkt erreicht hat und damit auch der Einfluß von Prädatoren höher wird. Die Merkmalskombination mobil/polyvoltin/wenig spezialisiert macht gerade Wanderschwebfliegen zu forst- und landwirtschaftlich bedeutenden Blattlausvertilgern. Will man sie ökonomisch im Rahmen der biologischen Schädlingsbekämpfung nutzen, ist eine sehr genaue Kenntnis ihrer individuellen Lebenszyklen unerläßlich. Gerade dem Phänomen der Migrationen muß hierbei wesentlich mehr Aufmerksamkeit als bisher geschenkt werden.

4.5 Allgemeine Aspekte der Schwebfliegenwanderungen

4.5.1 Verbreitung

Gatter (1981a) wies darauf hin, daß Wanderinsekten große Verbreitungsgebiete haben. Dies trifft auch auf die Wanderschwebfliegen zu.

Von den 18 als Saisonale Migranten eingestuften Arten (Tab. 3) sind neun wenigstens holarktisch verbreitet. Unter diesen Arten sind viele auch im nordorientalischen Bereich zu finden; eine Art *(Eristalis tenax)* ist sogar kosmopolitisch. Sieben der 18 Arten sind wenigstens paläarktisch verbreitet. Auch von diesen kommen die meisten auch noch nordorientalisch vor, das Areal von *Metasyrphus corollae* reicht bis in die Paläotropis, das von *Episyrphus balteatus* schließt die australische Region mit ein. Lediglich zwei der 18 Arten haben ein relativ kleines Verbreitungsgebiet: *Meliscaeva auricollis* und die nur in geringer Zahl wandernde *Eristalis pertinax* scheinen auf die westliche Paläarktis beschränkt zu sein.

Auch unter den 17 Dismigrantenarten sind acht wenigstens holarktisch und sieben wenigstens paläarktisch verbreitet. Zwei Arten *(Platycheirus manicatus, Parasyrphus punctulatus)* kommen nach heutiger Kenntnis nur in der westlichen Paläarktis vor.

Demgegenüber haben z. B. viele Arten der im Larvenstadium phytophagen, sehr artenreichen Gat-

tung *Cheilosia,* von denen für keine Species weitreichende Wanderungen nachgewiesen sind, recht beschränkte Verbreitungsgebiete.

4.5.2 Diapause und Migration

„Unter Diapause verstehen wir eine unter natürlichen Bedingungen mehrere Wochen, Monate oder sogar Jahre andauernde Depression im Wachstum embryonaler Gewebe oder der Ovarien, für welche die herrschende Temperatur und andere Außenfaktoren nicht allein verantwortlich gemacht werden können" (Schneider 1948), also eine endogen fixierte Ruheperiode (Sommerruhe, Winterruhe etc.) der Larve oder der Imago.

Auf den engen Zusammenhang zwischen der Diapause von Imagines und Migrationen machte zuerst Johnson (1969) aufmerksam. Beispiele aus dem Bereich der Schmetterlinge werden unten ausführlich dargestellt (4.5.4). Unter den Käfern (Coleoptera) ist der Marienkäfer *Coccinella septempunctata* L. die eindrucksvollste Wanderart in Europa. Die Jungkäfer schlüpfen meist zwischen Mitte Juli und Anfang August. In Gradationsjahren – die fast immer mit denen der aphidophagen Syrphiden zusammenfallen – klettern die Jungkäfer an Halmen hoch und starten an geeigneten Tagen, manchmal zu Millionen, zur Migration (Gatter & Gatter 1973, Hodec 1973). Bereits wenige Tage nach der kurzen Migrationsphase suchen die meisten Tiere Sommer- und Winterruhequartiere auf, die bis zum Frühjahr nicht mehr verlassen werden. Diesen Prädiapauseflügen (Hagen 1962, Williams 1961) folgen Nachdiapauseflüge im Frühling.

Während bei den zoophagen, sich meist von Blattläusen ernährenden Marienkäfern (vgl. 4.4) Pollennahrung nur sehr untergeordnete Bedeutung hat, können Syrphiden beim Vor- und Nachdiapauseflug unentwegt Pollennahrung zu sich nehmen. Dies könnte die Evolution der Langstreckenmigration im Sinne Johnsons (1969) begünstigt haben.

Wie oben gezeigt wurde (Tab. 3; 4.3), führen auch sämtliche als diapausierende Imagines überwinternden Schwebfliegenarten richtungsorientierte Saisonwanderungen aus, die im Herbst dem gezielten Aufsuchen günstiger Überwinterungsareale dienen, während die Nachdiapausewanderungen im Frühjahr in Gebiete führen, die gute Entwicklungsbedingungen gewährleisten. Direkte Hinweise auf diese Frühjahrswanderungen sind zwar spärlich (3.1; Gatter 1980, Westmacott & Williams 1954), was aber mit Sicherheit einerseits an der Unauffälligkeit der Tiere und ihrer im Frühjahr gegenüber dem Herbst erheblich niedrigeren Zahl hängt, andererseits aber auch daran, daß diesem Phänomen bisher kaum Aufmerksamkeit geschenkt wurde.

4.5.3 Generationenfolge und Migration

Gatter (1981a) untersuchte die mitteleuropäischen Schmetterlinge und stellte erstmals fest, daß es neben den Arten mit Diapause im Imaginalstadium (4.5.2) die Arten mit mehreren Generationen sind, die ausgeprägt migrieren. Bei den Schwebfliegen bestätigt sich dieses Ergebnis: sämtliche Saisonalen Migranten bilden in der Tat mehrere Jahresgenerationen aus (3.1, 3.2, Tab. 3).

Andererseits wandern nicht alle Arten, die in mehreren Jahresgenerationen auftreten. Unter den polyvoltinen Syrphiden haben sich, in Anpassung an die ökologischen Bedürfnisse einzelner Arten und Artengruppen, verschiedene Strategien herausgebildet, von denen Migration nur eine ist (vgl. 4.3). Die ausgeprägtesten Wanderer sind polyvoltine Arten, die zudem eine Winterruhe (Diapause) haben und vor und nach dieser Winterruhe wandern. Die sich im Jahresverlauf ergebenden Habitatänderungen und die unterschiedlichen Ansprüche während verschiedener Lebensphasen bringen die Notwendigkeit zum Ortswechsel mit sich (Gatter 1981c, Gatter & Gatter 1990). Die weitere Erforschung dieser vitalen Wanderer wird noch manches aufregende Ergebnis bringen.

4.5.4 Die Stellung der Schwebfliegen innerhalb der Wanderinsekten

Der Monarch *Danaus plexippus* L. (Lepidoptera) gilt als das klassische Wanderinsekt schlechthin. Die Herbstgeneration dieses in der Alten und Neuen Welt beheimateten Schmetterlings wandert in Amerika aus Kanada und den Vereinigten Staaten im Extremfall bis in das mexikanische Winterquartier, um dort gesellig auf bewaldeten Berggipfeln zu überwintern. Nach der Überwinterung wandern die Falter nordwärts. Im Verlauf ihrer Wanderung (und nicht erst am Endpunkt) legen die ♀♀ Eier ab. Die Nachkommen der Überwinterungsgeneration erreichen dann wieder die Gebiete des nördlichen Amerika (Urquhart 1960). – Der Monarch wandert kompaßorientiert und erreicht seine Überwinterungsplätze navigierend.

In Europa kennen wir innerhalb der Schmetterlinge ähnliche Fälle. Geselliges Überwintern ist allerdings nicht bekannt; so waren – wenn man von den methodisch unglücklichen Versuchen bei Roer (z. B. 1961) absieht (Baker 1978) – bisher keine Massenkennzeichnungen möglich, die die Verfolgung der Zugwege einzelner Individuen ermöglicht hätten. Mit Distelfalter *Vanessa cardui* L. (Harz 1975, Baker 1972), Admiral *Vanessa atalanta* L. (Baker 1972, Gatter 1981a), Gammaeule *Autographa gamma* L. (Baker 1978, Gatter 1981a) und anderen Arten haben wir Schmetterlinge, deren Migrationszyklus dem des Monarchen *Danaus plexippus* ähnlich ist. Bei Distelfalter (Baker 1978), Windenschwärmer *Agrius convolvuli* L. (Gatter & Gatter 1990) und weiteren Arten können sich bei diesen Wanderungen Verbindungen bis in den nordafrikanischen und afrotropischen Bereich ergeben. Vergleichen wir diese Lebenszyklen und Flugleistungen mit denen von *Episyrphus balteatus* (S. 44), so finden wir zahlreiche Parallelen: Die Herbstgeneration zieht wochenlang, möglicherweise über Monate hinweg zu bisher unbekannten Überwinterungsgebieten. In Mitteleuropa, den Alpen und den Pyrenäen führt die Wanderung kompaßorientiert in südwestliche Richtung. Die ♀♀ offensichtlich derselben Generation wandern im Frühjahr wieder nach Norden. Ihre Nachkommen erreichen Nordeuropa, wo sie nicht überwintern können. Die Sommergeneration wandert wiederum nach Süden.

Hinsichtlich ihrer physischen Leistungsfähigkeit sind Schwebfliegen vielen Wanderfaltern überlegen. Bei der Überwindung von Gebirgspässen ist z. B. der Kleine Kohlweißling *Pieris rapae* L. als Saisonaler Migrant unseren Wanderschwebfliegen derselben Kategorie weder in der Vitalität noch in der Fluggeschwindigkeit gewachsen. Ein Vergleich der Relation von Körpergröße/-gewicht zur Flügelfläche zwischen *Episyrphus balteatus* und *Danaus plexippus* macht wahrscheinlich, daß die Flugleistungen dieser Schwebfliegenart denen des Monarchen kaum nachstehen. Ihre Flugleistungen und -geschwindigkeiten werden wohl nur von wenigen Libellen (Odonata) und Schmetterlingen (Lepidoptera) übertroffen.

Auch unter den wenigen Wanderinsekten, die Spitzbergen über das Nordmeer erreichen (Lokki et al. 1978), ist eine Schwebfliegenart (Elton 1925). Zusammen mit einer Reihe anderer Syrphidenarten gehört *balteatus* mit zu den leistungsfähigsten Wanderinsekten im paläarktischen Raum. Vergleichen wir quantitatives Ausmaß und Regelmäßigkeiten dieser Schwebfliegenwanderungen mit dem der Wanderungen der Schmetterlinge, Libellen und anderen Wanderinsekten, so stellen die Schwebfliegen das wohl eindrucksvollste Beispiel für Insektenwanderungen in Europa.

Neben diesen alljährlichen Migrationen über weite Strecken bei den physiologisch starken Fliegern haben wir ein weites Feld von verschiedenen Formen der Dismigration (3.1.), wobei alle hier abgehandelten Migrationsformen und die Begriffsbestimmungen (3.1., Gatter 1981a, 1981c) nicht als starre, restriktive Einteilung verstanden werden sollten (Baker 1978). Schon in den Abschnitten 3.1 und 3.2 wird deutlich, daß es zahlreiche Übergänge zwischen Migrationsformen gibt; trotzdem ist es notwendig, mit der begrifflichen Kennzeichnung bestimmter biologischer Abläufe Abgrenzungen zu anderen zu schaffen – schon um dadurch zu weiterer Forschungsaktivität anzuregen.

Bei den Dismigranten unter den Schwebfliegen kommen dem Migrationsvorgang die unterschiedlichsten Bedeutungen zu. Der Verteilung der Individuen im Raum dienen die einfachen Formen der

Anemomigration oder Verdriftung und der Expansiven Dismigration. Durchmischung der Populationen, das Auffinden neuer Habitate und die Möglichkeit der Arealerweiterung sind einige der Ziele dieser emigrationsähnlichen Formen der Wanderung. Im Ergebnis sind sie vielfältig: in der durchschnittlichen Emigrationsdistanz einer Generation unterscheiden sich die Wanderungen der winzigen und sehr flugschwachen *Neoascia podagrica* von den Einflügen der großen, flugphysiologisch kräftigen *Volucella zonaria* zwar sehr, biologisch ist es aber derselbe Vorgang.

Bei allen am Randecker Maar wandernden Dismigranten werden ♀♀ häufiger in den Reusen gefangen als ♂♂ (3.1., Tab. 5). Oft sind erstere erheblich weniger flugtüchtig. Besonders deutlich ist dies z. B. bei *Melanostoma mellinum* (S. 29). Hier dienen die Migrationen der ♀♀ wohl in erster Linie dem Aufsuchen günstiger Eiablageplätze, während die ♂♂ den aktiveren Teil des Migrationsprozesses übernehmen. Das würde den Dispersionsprozessen entsprechen, die wir von Spinnerarten (Bombyces, Lepidoptera) kennen. Auch hier kommt den in vielen Fällen flugagileren ♂♂ der aktivere Teil des Dismigrationsgeschehens zu, während sich die schwerfälligen ♀♀ nur wenig von ihrem Schlüpfort entfernen (Schwerdtfeger 1977). Als bemerkenswerten Fall konnte Mikkola (1968) Einflüge der südostrussischen Rasse des Schwammspinners *Lymantria dispar* L. vom zentralen Eurasien nach Finnland nachweisen. Im Extremfall wandern selbst Männchen von Arten, deren ♀♀ flügellos sind, große Strecken. Im 19. Jahrhundert erreichte der Große Frostspanner *Erannis defoliaria* Cl. Helgoland in ungeheuerer Zahl (Gätke 1900).

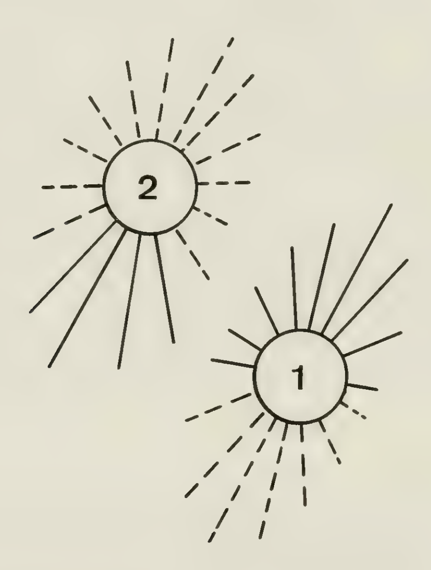


Abb. 28: Beispiel einer Saisonalen Dismigration unter dem Einfluß vorherrschender Windrichtungen: Wanderinsekten, die sich beispielsweise im Mittelmeerraum (1) entwickelt haben, dismigrieren im Frühjahr. Nach Süden wandernde Tiere kommen um (gestrichelte Linien). Nach Norden dismigrierende Tiere erzeugen eine zweite Generation in Mitteleuropa (2). Die mitteleuropäischen Tiere wandern im Herbst wieder mit der Vorzugswindrichtung. Nach Norden wandernde Tiere kommen um, nach Süden wandernde errreichen das Herkunftsgebiet (aus Gatter 1981 a).

Fig. 28: Examples for seasonal dismigration under the influence of predominant wind directions: Migratory insects which developed in the Mediterranean area (1) dismigrate in spring. Insects migrating southward will die (broken lines). Insects migrating northward produce a second generation in Central Europe (2). In autumn, they will migrate again with predominant wind directions. Insects migrating northward will die, insects migrating south will be able to return to the Mediterranean area (see Gatter 1981 a).

Neben diesen Formen der Zerstreuungswanderung gibt es bei den polyvoltinen Arten sicher alle Übergänge zu höheren Migrationsformen. Bei flugschwachen Arten, die den bodennahen Bereich selten verlassen, würde die biologische Bedeutung dieser Dismigrationen der Expansiven Migration entsprechen. Sobald sich aber wenigstens kleine Teile einer Population in größere Höhen begeben, setzen sie sich den Windströmungen aus und wandern mit ihnen (Abb. 28). Seit den Untersuchungen von Glick (z. B. 1939, 1942, 1960) wissen wir, daß sich fast alle Insektengruppen und selbst Milben und Spinnen in großer Höhe mit saisonalen Vorzugswindrichtungen verdriften lassen. Ist diese Form der Migration erfolgreich, so wird daraus die „Produktion von Migranten durch Selektion" im Sinne Johnsons (1969). Es gibt zahlreiche Hinweise, daß viele Insektenarten Strategien entwickelt haben, aus dem Windangebot bestimmte, für sie vorteilhafte Winde zu selektieren (Baker 1978, Gatter 1977b, 1981a; vgl. Abb. 28).

Ebenso ist belegt, daß Dipteren außerhalb Europas so extreme Wanderungen ausführen, wie wir sie für *Episyrphus balteatus* und andere Arten annehmen. Johnson (1969) nennt einen Fall, der vermuten läßt, daß sich selbst Stubenfliegen *Musca domestica* L. (Muscidae) über große Entfernungen in Höhen von 300–1 500 m mit dem Wind verfrachten lassen. Für die amerikanische Fliege *Chochliomyia hominivorax* Coq. (Calliphoridae) sind individuelle Zugentfernungen von ♀♀ über 290 km nachgewiesen. Sie sucht im Herbst nahrungsreiche Gebiete einige hundert oder tausend Kilometer weiter südlich auf und wandert im Frühjahr zurück nach Norden. In beiden Zugzeiten wird angenommen, daß Selektion die Fliegen fördert, die vorteilhafte Winde nutzen. Extrementfernungen zwischen Winteraufenthalt und den nördlichsten Sommerfunden liegen 2400 km auseinander (Baker 1978). Die australische „bushfly" *Musca vetustissima* Walk. (Muscidae) wandert saisonal und legt dabei z. T. Entfernungen von 1 500 km in offenbar einer Generation zurück (Hughes & Nicholas 1974).

Unterschiedliche Lebenszyklen, kurze Lebensdauer einzelner und Langlebigkeit anderer Syrphidenarten haben unterschiedliche Anpassungen an die Jahreszeiten und an die vorhandene Nahrung notwendig gemacht. Die unterschiedlichen Habitatansprüche von Larven und Imagines verschiedener Generationen zu verschiedenen Jahreszeiten wie auch die Ansprüche an den Überwinterungsort haben bei den Schwebfliegen zu einer breiten Palette von Anpassungen geführt, auf die mit Wanderung reagiert wird. Baker (1969, 1978) konnte nachweisen, daß zu- und abnehmende Tageslängen bzw. Temperaturen während der Larvenzeit bzw. Überwinterung steuernd auf die Zugrichtung einwirken, die ein Insekt später einschlägt. Diesbezügliche Ergebnisse für Dipteren stehen bisher völlig aus.

5. Zusammenfassung

Im Zeitraum 1975–1987 wurden an der Station Randecker Maar/Schwäbische Alb (SW-Deutschland; 48.35 N, 9.31 E; 772 m über NN) die Wanderungen der Schwebfliegen erforscht. Zwölf Jahre lang wurde hier zwischen Mitte/Ende Juli und Anfang Oktober (Tab. 1) eine nach Norden geöffnete Reuse betrieben, die nach Süden fliegende Insekten erfaßte (S-Reuse). Während fünf Jahren wurden zusätzlich mit einer baugleichen, nach Süden geöffneten Reuse Insekten gefangen, die nach Norden flogen (N-Reuse). Während dieser Zeit wurden 90049 Syrphiden in der S-Reuse und 9815 Syrphiden in der N-Reuse gefangen und determiniert (Tab. 1). Die Leerung der Reusen erfolgte stündlich.

Mit Hilfe dieses Materials wird die **Phänologie der am Randecker Maar** im Untersuchungszeitraum mit über 50 Exemplaren **festgestellten Arten** beschrieben (3.1).

Untersucht und für jede Art dargestellt werden jeweils folgende phänologischen Aspekte:
– Jahreszeitliches Vorkommen der Art;
– Jahreszeitliches Vorkommen der Geschlechter;
– Tageszeitabhängige Aktivität der Art;
– Tageszeitabhängige Aktivität der Geschlechter;
– Veränderungen der tageszeitlichen Aktivität im Jahresverlauf;
– Unterschiede zwischen S-Reuse und N-Reuse;

– Geschlechterverhältnis;
– Einflug in die S-Reuse in Abhängigkeit von der Windrichtung.

Zur Einordnung dieser Ergebnisse in den Zusammenhang enthalten die Artabschnitte kurze Abrisse der Biologie der Art und eine Zusammenfassung der bisherigen Wanderbeobachtungen. Wenn möglich, wird die Art abschließend einer der bekannten Migrationsformen zugeordnet (Definitionen s. 3.1).

Um einen Überblick über die Wanderarten in Europa zu erhalten, werden darüber hinaus auch Arten dargestellt, die am Randecker Maar nur in geringer Zahl in Erscheinung treten, andernorts aber als Wanderer beschrieben wurden (3.2).

Daraus ergibt sich eine **Darstellung und Bewertung des Status sämtlicher als Wanderarten bekannten Schwebfliegen Europas** (Tab. 3).

Dabei wurden **typische Merkmale der Phänologie Saisonaler Migranten** (Arten s. Tab. 3), die richtungsorientierte Wanderungen in Winter- und Sommerareale ausführen, deutlich:

1. Der Vergleich der Fangergebnisse beider Reusen und direkte Beobachtungen zeigen, daß die spätsommerlichen und herbstlichen Flugbewegungen gerichtet in südliche und südwestliche Richtungen führen.
2. Einige direkte Beobachtungen machen deutlich, daß Saisonale Migranten im Frühjahr in nördliche Richtungen wandern.
3. Zwischen dem Vorkommen am Randecker Maar und dem am 350 km südwestlich gelegenen Col de Bretolet bestehen charakteristische Unterschiede. Die meisten Saisonmigranten weisen am Col de Bretolet ein später liegendes Maximum auf. Wie bei Zugvögeln dürfte das zeitversetzte Auftreten auf die unterschiedliche Lage der Stationen zurückgehen; demnach wird die in Zugrichtung nachgeschaltete Station am Bretolet später erreicht (4.1).
4. Während die meisten Saisonwanderer am Randecker Maar und an weiter nördlich liegenden Stellen ein weitgehend ausgeglichenes Geschlechterverhältnis aufweisen, dominieren in den Alpen die ♀♀ sehr stark. Für *Episyrphus balteatus* konnte nachgewiesen werden, daß die ♀♀ sehr viel langlebiger sind. Die wesentlich kurzlebigeren ♂♂ nehmen anfangs noch an der Migration teil (Randecker Maar), sterben aber in ihrem Verlauf ab (Alpen) (4.2; Tab. 5). Gegen Ende der Zugzeiten erscheinen auch am Randecker Maar fast nur noch ♀♀. Der Durchzugs-Median liegt deshalb bei ♀♀ stets später als bei ♂♂.
5. Saisonale Migranten wandern nur bei Gegenwinden in bodennahen Schichten, um den widrigen Einfluß des Windes zu verringern. Dagegen nutzen sie den fördernden Einfluß von Rückenwinden, indem sie in größere Höhen aufsteigen. Dementsprechend werden Südwanderer fast ausschließlich bei Winden aus südlichen Richtungen gefangen (3.4).
6. Sowohl das jahreszeitliche als auch das tageszeitliche Muster des Auftretens der häufigen Saisonmigranten zeigt von Jahr zu Jahr, von den hohen Populationsschwankungen abgesehen, relativ geringe Unterschiede. Das spricht gegen eine exogene Auslösung und für eine genetische Fixierung der Migrationsphasen.

Die **Gruppe der Dismigranten** (Arten s. Tab. 3), die aktive Zerstreuungswanderungen ausführen, ist weniger eindeutig charakterisiert. Nicht für alle Arten gelten sämtliche der angeführten **Merkmale der Phänologie der Dismigranten** – eine Folge unterschiedlicher Funktionen, Ausmaße und Reichweiten dieser Zerstreuungswanderungen (vgl. 4.5.2).

1. Die Unterschiede zwischen den Fangsummen in den beiden Reusen sind oft nicht sehr hoch; eine eindeutige Vorzugsrichtung ist damit nicht erkennbar. Allerdings lassen die bei manchen Dismigranten höheren Unterschiede vermuten, daß sie gezielt günstige Windrichtungen nutzen, um in Vorzugsrichtungen zu wandern.
2. Zwischen dem jahreszeitlichen Auftreten am Randecker Maar und in den Alpen (Col de Bretolet) besteht meist kein Unterschied (4.1).
3. Das Geschlechterverhältnis zwischen Randecker Maar und Col de Bretolet zeigt keine gleichsinnigen Veränderungen, die auf einen Zusammenhang schließen lassen (4.2.; Tab. 5).
4. Am Randecker Maar dominieren bei allen Dismigranten die Weibchen, deren Flugaktivität im bodennahen Bereich im Zusammenhang mit dem Aufsuchen günstiger Eiablageplätze größer ist als die der ♂♂.
5. Saisonale Dismigranten verfügen nicht über die weitreichende Strategie der Meidung widriger und Nutzung günstiger Winde der Saisonwanderer. Bei ihnen finden auch Mitwindwanderungen wenigstens zum Teil in Bodennähe statt. Im Gegensatz zu reinen Driftinsekten geraten Dismigranten bei allen Windrichtungen in die Reuse; Mitwindbewegungen überwiegen aber leicht (3.4).

Für verschiedene ökologische Gruppen unter den Schwebfliegen sind **Saisonale Migrationen integraler Bestandteil des Lebenszyklus** (4.3, 4.5):

1. Saisonwanderungen sind nur von Arten mit zoophagen (aphidophagen) Larven und Arten mit aquatischen sapro-/microphagen Larven bekannt.

2. Zu den Saisonwanderern gehören insbesondere die Arten, die als Imago oder Puparium überwintern (vgl. Tab. 3). Diese Arten überstehen den Winter im nördlichen Bereich ihres Verbreitungsgebietes nicht oder nur in relativ geringer und von den Witterungsbedingungen des Winters stark abhängiger Anzahl. Sie wandern deshalb in jedem Frühjahr dort ein; im Herbst finden Rückwanderungen in südliche Richtungen statt. – Da auch einige Arten, die im Larvenstadium überwintern, solche Wanderungen durchführen, kann vermutet werden, daß auch für sie das Überwinterungsrisiko im südlichen Europa geringer ist.

3. Der adaptive Wert der Südwanderungen im Sommer/Herbst besteht in einer Vergrößerung der Überlebenschancen im Winter. Der adaptive Wert der Nordwanderungen im Frühjahr kann für die aphidophagen Arten darin gesehen werden, daß in Mitteleuropa dann optimale Entwicklungs-(Blattlausmaximum) und Ernährungsbedingungen (Reichtum an „Fliegenblumen") für Larven und Imagines bestehen, für die aquatischen Formen darin, daß im humiden Bereich die als Larvenhabitate benötigten Kleingewässer in wesentlich höherer Dichte und mit geringerem Austrocknungsrisiko anzutreffen sind als im sommerlich-ariden Südeuropa.

Dismigrationen dienen im wesentlichen dazu, Stellen mit für die Larven günstigen Lebensbedingungen leichter zu erschließen. An solchen Wanderungen haben wieder in erster Linie Arten teil, deren Larven zoophag sind (4.3), d. h. auf eine in Raum und Zeit nicht vorhersagbar auftretende Ressource angewiesen sind (Arten s. Tab. 3).

Aphidophage Schwebfliegen haben unterschiedliche Lebenszyklen, die zum Teil mit dem Frühjahrs- und/oder dem Herbstmaximum der Blattlauspopulationen korreliert sind (mono- und bivoltine Arten; vgl. Tab. 3). Um sich während des Sommerminimums der Blattläuse erfolgreich fortpflanzen zu können, müssen polyvoltine Syrphidenarten in ihren Lebenszyklus Wanderphasen integrieren. Darüber hinaus sind sie hinsichtlich des Habitats und der Larvenbeute wenig spezialisiert. Zwei Gruppen konkurrieren dabei um die Larvennahrung: Die Gruppe der Saisonalen Migranten und die der Saisonalen Dismigranten (vgl. Tab. 3). Während erstere in der direkten Nahrungskonkurrenz überlegen sind, können letztere ein wesentlich weiteres Nahrungsspektrum nutzen (4.3).

Bei den Schwebfliegenarten, deren Larven terrestrisch saprophag oder phytophag sind, sind **keine weitreichenden Wanderungen** nötig, um die in Raum und Zeit vorhersagbar auftretende Larvennahrung zu erschließen. Während unter den Saprophagen einige Arten über kurze Strecken dismigrieren (Tab. 3), sind von den gewöhnlich stark spezialisierten Phytophagen keine Wanderungen bekannt (4.3).

Ein **Vergleich mit anderen Wanderinsekten** zeigt, daß das Wanderverhalten der Schwebfliegen weitgehende Ähnlichkeiten mit dem anderer bekannter Wanderinsekten v. a. unter den Schmetterlingen (Lepidoptera) aufweist (4.5).

Enge Zusammenhänge bestehen zwischen Diapause und Migration (als Imagines diapausierende Arten migrieren; 4.5.2), zwischen Generationenzahl und Migration (v. a. polyvoltine Arten migrieren; 4.5.3) und zwischen Verbreitungsgebiet einer Art und ihrem Wanderverhalten (Wanderer haben riesige Verbreitungsgebiete; 4.5.1).

Die Leistungsfähigkeit einzelner Schwebfliegenarten und Ausmaß und Regelmäßigkeit ihrer Wanderungen machen die Migrationen der Schwebfliegen zum eindrucksvollsten Beispiel für Insektenwanderungen in Europa.

Darüber hinaus gehört der weit überwiegende Teil der land- und forstwirtschaftlich wichtigen Blattlausvertilger unter den Syrphiden in die Gruppe der aphidophagen Wanderschwebfliegen. Bei allen Versuchen, einzelne dieser Schwebfliegenarten im Rahmen der biologischen Schädlingsbekämpfung zu nutzen, ist eine genaue Kenntnis des individuellen Lebenszyklus von entscheidender Bedeutung. Dabei wurde in der bisherigen Forschung die Bedeutung des Phänomens der Wanderungen weit unterschätzt.

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Seit dem Bestehen der Station am Randecker Maar haben sich zahlreiche Mitarbeiter große Verdienste erworben beim Aufbau und der Unterhaltung von Station und Fanganlagen, durch technische Hilfe im Bereich der Datenerfassung und -auswertung und bei der Betreuung der Mitarbeiter der Station. Dafür danken wir R. Braun, E. Blocher, B. Dauner, Dorothea Gatter, Martin Gatter, R. Gardner, H. Grau, Herr und Frau Dr. Höß, Dr. Hohloch, Barbara Hoschek, E. Kotzke, V. Kirchner, R. Laih, Dr. H. Löhrl, Prof. Dr. H. Mattes, S. Maskow, E. Miller, W. Neuhäuser, Frau P. Schmid, K. Sill, J. Schweier, Chr. und I. Schwotzer, H. J. Ullrich, H. Graf Westarp (†) und I. Gräfin Westarp (†).

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Zur Dynamik von Nachtfalter-Artenspektren

Turnover und Dispersionsverhalten als Elemente von Verbreitungsstrategien

Axel Hausmann

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Zur Dynamik von Nachtfalter-Artenspektren:

TURNOVER UND DISPERSIONSVERHALTEN ALS ELEMENTE VON VERBREITUNGSSTRATEGIEN

von **Axel Hausmann**

Inhalt

II. EXPERIMENTELLER TEIL: DISPERSIONSVERHALTEN UND TRIVIAL MOVEMENT

I. ERFASSENDER TEIL: DAS ARTENSPEKTRUM

1. EINLEITUNG

Die Dynamik von Arten, von Populationen einer Art und von Artenspektren eines definierten Areals sind wichtige Gesichtspunkte für ökologische Beurteilungen einer Art oder eines Biotops und somit für den Naturschutz bedeutsam.
Bei vielen Tiergruppen sind wir heute, was die in den Artenspektren stattfindenden Austauschprozesse betrifft, auf einem einigermaßen befriedigenden Kenntnisstand angelangt, wie bei den Vögeln (z.B. DIAMOND, 1969; JONES & DIAMOND, 1976; u.s.w.), oder den sessilen marinen Organismen (SCHOENER & SCHOENER, 1981).

Die Tagfalter sind bezüglich der Artendynamik (z.B. Dispersionsverhalten) ebenfalls recht gut untersucht, hier vermittelt vor allem die amerikanische (z.B. EHRLICH, 1961; EHRLICH & DAVIDSON, 1961; SCOTT, 1975; WATT et al., 1977; SCHRIER et al. 1976) und die englische (z.B. DOWDESWELL, FISHER & FORD, 1940 und 1949) Literatur ein einigermaßen solides Basiswissen, bestehend aus vielen Einzelinformationen. Zu interessanten Ergebnissen kamen SMOLIS & GERKEN (1986) in ihrer Arbeit über die intrapopulare Mobilität von Widderchen (Zygaenidae).
Was jedoch auf der Ebene der Artenspektren die Austauschprozesse betrifft, die diese Artendynamik durch ständiges lokales Verschwinden und Wiederbesiedelung hervorruft, ist vergleichsweise wenig publiziert worden (z.B. REICHHOLF, 1986). Einen Versuch, den einheimischen Tagfalterarten verschiedene Verbreitungsstrategien zuzuordnen, unternahm WEIDEMANN (1986a; 1986b).

Bei den Nachtfaltern ergeben die bisher publizierten Arbeiten bezüglich der genannten Thematik erst ein sehr bruchstückhaftes Bild. Erst UTSCHICK (1989) versucht bei einer allerdings recht kleinen Stichprobe aus Lichtfallenfängen am Inn eine Biotopbeurteilung über Artenumsatz-Raten. Ohne detailliertere Diskussion reißt auch MALICKY (1974b) durch die Ermittlung einer Artenübereinstimmung von Jahr zu Jahr die Problematik an.
Während beispielsweise bei den Vögeln selbstverständlich zwischen Brutvögeln und Durchzüglern unterschieden wird, fehlt eine solche Differenzierung - abgesehen von einigen wenigen Wanderfalterarten - in Publikationen von Nachtfalter-Artenspektren in fast allen Fällen. Dies liegt in erster Linie an den durch Nachtaktivität und fehlendes Revierverhalten verständlicherweise erschwerten Erfassungsbedingungen.
Nachdem in einer vorbereitenden Arbeit bei der Noctuiden-Unterfamilie Amphipyrinae in der Methodik des Lebend-Lichtfallenfangs ein Jahr-zu-Jahr-Artenaustausch (Turnover) von ca. 35 % festgestellt wurde, aber offenbleiben mußte, wie stark die Methodik dieses Ergebnis beeinflußte, war nun die Idee, ein ganzes Fangstellen-Netz zu errichten. Mehrere Fallen sollten bei geringeren Distanzen parallel in den selben Nächten betrieben werden, mit dem Ziel, anhand ausgewählter Arten Zusammenhänge zwischen der Dynamik der Arten in Raum und Zeit und Austauschprozessen in der Zusammensetzung der Artenspektren von definierten Arealen zu erarbeiten.
Hauptgegenstand der Untersuchung sollen die nachtaktiven Macroheteroceren-Familien in der Methodik des Lebend-Lichtfallenfangs sein. Aus Markierungexperimenten resultieren weitere Hinweise, vor allem auf die Dispersionsdynamik der Arten.

In fast allen Fällen waren bisher ähnliche Untersuchungen auf die großräumige Dynamik der Wanderfalter gerichtet, jedoch können sich Erkenntnisse gerade über die Austauschprozesse, die sich in Distanzen von unter 5 km abspielen, als nützliche Hilfsmittel erweisen, beispielsweise für Programme im Zuge von Biotopvernetzungsmaßnahmen.

2. UNTERSUCHUNGSGEBIET

2.1. GROSSRAUM

Das Gemeindegebiet Oberschleißheim (31 km², 475-488 m ü. NN) liegt an einer interessanten Stelle im Nordwesten der Münchner Schotterebene (vergleiche hierzu die Übersichtskarte, Abb. 1).

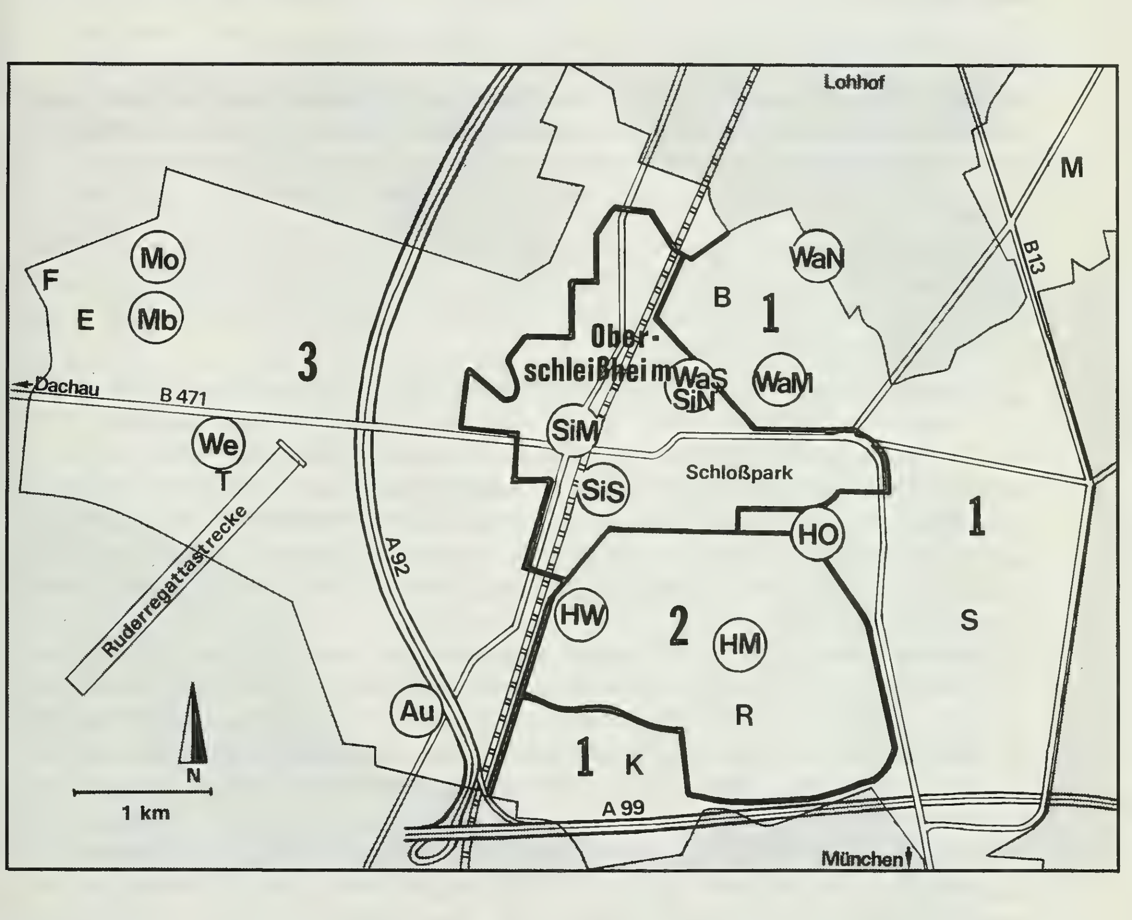


Abb. 1: Gemeindegebiet Oberschleißheim. 1 = Kiefern-Eichenwaldgürtel; 2 = Flughafengebiet (Magerrasen); 3 = Dachauer Moos (entwässert und größtenteils landwirtschaftlich genutzt). Abkürzungen der Fundorte siehe Text (nach HAUSMANN, 1988, verändert).

Types of habitat in the municipality of Oberschleissheim near Munich. 1 = Pine-Oak forest belt, 2 = air strip (low fertility pasture), 3 = fen area of Dachau (drained and mostly changed to arable land). Abbreviations cf text.

Das eigentliche Siedlungsgebiet (48°15 N / 11°34 E) ist im Nordosten und Osten von einem relativ trockenen Kiefern-Eichenwald ("Vaccino-vitis-idaea-Quercetum"), im Süden von einem Magerrasengebiet, das einem Trespen-Halbtrockenrasen (Mesobrometum erecti) nahekommt, und im Westen vom ehemaligen Niedermoor "Dachauer Moos", das jetzt weitgehend landwirtschaftlich genutzt ist, begrenzt (siehe auch HAUSMANN, A., 1988; HAUSMANN, S., 1982, 1984, 1987).
Das Gelände ist, von unbedeutenden Bodenwellen abgesehen, eben. Im ganzen Gebiet bildet ein aus tonigen und sandigen Mergeln bestehender tertiärer Flinz eine wasserstauende Schicht, die von ca. 15 Meter mächtigen quartären und postglazialen Schottern bedeckt ist (vergleiche HAUSMANN 1984 und 1987, Bayerisches Geologisches Landesamt briefl.).

2.2. BOTANISCHE CHARAKTERISTIK DER FALLENSTANDORTE

Da praktisch alle Biotope in irgendeiner Weise vom Menschen beeinflußt oder sogar geschaffen wurden, ist die im folgenden teilweise getroffene Einteilung in Pflanzengesellschaften oft nur tendenziell zu verstehen.

Siedlung
Wie es für Wohngebiete typisch ist, zeichnet sich auch der Siedlungsbereich Oberschleißheim durch eine uneinheitliche, reichhaltige Staffelung der Vegetationselemente aus. Standort und Artenzusammensetzung sind fast ausschließlich vom Menschen nach ästhetischen Gesichtspunkten bestimmt.

- Siedlung Süd ("SiS"): Der Fangplatz befindet sich auf einem knapp 2 ha großen ungenutzten Geländestreifen, der auf einer Seite vom Würmkanal, auf den anderen Seiten von Gärten begrenzt ist. Die Krautschicht besteht fast nur aus Brennessel-Giersch-Saum (*Urtico dioicae-Aegopodietum*), der stark von Brombeere (*Rubus fruticosus*) durchsetzt ist. Im artenreichen Baumbestand dominieren Gewöhnliche Esche (*Fraxinus excelsior*), Schwarzer Holunder (*Sambucus nigra*), Hybrid-Pappel (*Populus euramericana*) und Weiden (*Salix*). Der Beschattungsgrad beträgt ca. 70 %.
- Siedlung Mitte ("SiM"): Die nähere Umgebung der stark befahrenen Straßenkreuzung ist von Gärten beherrscht. Botanisch interessanter ist v.a. die Begleitflora des Schloßkanals in 50 (fragmentarisch) bis 100 m Entfernung: Charakteristisch sind Rohrschwingel-Rasen (*Dactylo-Festucetum arundinaceae*), Blaubinsen-Roßminzen-Gesellschaft (*Junco inflexi-Menthetum longifoliae*) sowie Weiden und Schneeball (*Viburnum*).
- Siedlung Nord ("SiN"): Es handelt sich hier um den Garten des Verfassers, der Fangplatz befindet sich auf der Südseite des Hauses. Das Siedlungsgebiet entstand 1952 unter partieller Rodung des Berglwaldes, der Waldcharakter blieb jedoch bestimmend. Unter den Bäumen dominieren 15-20 m hohe Kiefern (*Pinus sylvestris*), Stieleiche (*Quercus robur*), Gemeine Fichte (*Picea abies*), Hängebirke (*Betula pendula*), Winterlinde (*Tilia cordata*) und Hainbuche (*Carpinus betulus*). Der Beschattungsgrad beträgt ca. 60 %. Im Garten wurde der größte Teil der Wiesenfläche (ca. 200 m^2) in den Jahren seit 1985 abgemagert, was zu einer sehr artenreichen Krautschicht führte. In manchen anderen Gärten sind Ehrenpreis-Erdrauch-Gesellschaften (*Veronico-Fumarietum officinalis*) zu finden.

Wald

- Wald Süd ("WaS"): Dieser Standort befindet sich nur 30 m vom letztgenannten entfernt, nämlich auf der gegenüberliegenden Seite des Hauses. Hier erstreckt sich ein zwischen den Gärten liegender 20-40 m breiter Waldstreifen, der mit dem 150 m entfernten Berglwaldgebiet in direkter Verbindung steht. Es dominiert die Gemeine Fichte bei einem Beschattungsgrad von ca. 90 %. Erwähnenswert sind ein Bergweidenröschen-Stinkstorchschnabel-Saum (*Epilobio montani-Geranietum robertiani*) sowie ein Schlehen-Weißdorngebüsch (*Pruno spinosae-Crataegetum*) in je 20-30 m Entfernung (Lageskizze siehe 8.1.).
- Wald Mitte ("WaM"): Der Fangplatz befand sich auf einer 0,5 ha großen baumlosen Fläche im Berglwald (ca. 150jähriger Kiefern-Eichenwald mit starkem Laubholzunterwuchs), die in der Vergangenheit als Wildacker genutzt wurde, im Untersuchungsjahr jedoch von Pionierpflanzen wie Acker-Kratzdistel (*Cirsium arvense*), Gewöhnlichem Pastinak (*Pastinaca sativa*), Gemeinem Beifuß (*Artemisia vulgaris*) aber auch von Tüpfel-Johanniskraut (*Hypericum perforatum*) und Gänse-Fingerkraut (*Potentilla anserina*) dominiert war. Die Flächenränder bestehen aus Schlehen-Weißdorn-Gebüsch (*Pruno spinosae-Crataegetum*) mit viel (angepflanztem) Liguster (*Ligustrum vulgare*).
- Wald Nord ("WaN"): Der Standort befindet sich im relativ naturnah gestalteten Wasserwerksgelände am nordöstlichen Rand des Berglwaldes. Vor ca. 10 Jahren bestand die Fläche (wie heute noch in der näheren Umgebung) aus einem ziemlich abrupt in das angrenzende Ackerland übergehenden forstwirtschaftlich genutzten Hochwald. 50 m südöstlich bzw. 100 m westlich von "WaN" liegen die Fangplätze "WNo" und "WNw" (siehe Lageskizze).

  Die ziemlich abgemagerten arten- und blütenreichen Wiesenflächen sind an manchen Stellen noch von Pionierpflanzen dominiert (Ackerkratzdistel, Gewöhnlicher Pastinak), sie kommen an anderen Stellen jedoch dem Mittelklee-Odermennig-Saum (*Trifolio medii-Agrimonietum eupatoriae*) nahe, häufig ist weiterhin die bunte Kronwicke (*Coronilla varia*). Diese Magerrasenflächen sind mit ähnlichen Biotopen in der Gegend der Fröttmaninger Heide und des Mallertshofer Holzes ("M") im Osten über Trittstein-Lebensräume im Abstand von 100-300 m vernetzt. Am Standort "WNo" befindet sich ein ca. 20-30 m^2 großes Teichröhricht (*Scirpo-Phragmitetum*).

  Die von jungen Bäumen durchsetzten Gebüschflächen sind äußerst artenreich und haben manchmal, vor allem an "WNw" den Charakter eines Schlehen-Weißdorn-Gebüsches (*Pruno spinosae-Crataegetum*).

  Im Süden schließt ein Kiefern-Hochwald (Unterwuchs nur Him- und Brombeere) an, in der Waldfläche im Südwesten sind dagegen Wald-Kiefer und Gemeine Fichte zu ungefähr gleichen Teilen vertreten. In der Nähe des Fangplatzes WNw ist eine ca. 100 m^2 große Buchenenklave (*Fagus sylvatica*) eingestreut und im Norden umgrenzt das Gelände schließlich ein kleines Fichtenwäldchen.

  Der Flächeninhalt des teilweise verbuschten Magerrasens im Wasserwerksgelände beträgt ca. 2,3 ha. Wenn man bedenkt, daß auch Tiere, die sich im toten Winkel der Falle A (WaN) befanden (bereits relativ stark verbuschte Wiesenfläche), schon durch geringe Ortsveränderungen in den Einzugsbereich der Falle gelangten, dann wird deutlich, daß durch die 3 Standorte fast die gesamte Fläche abgedeckt wurde.

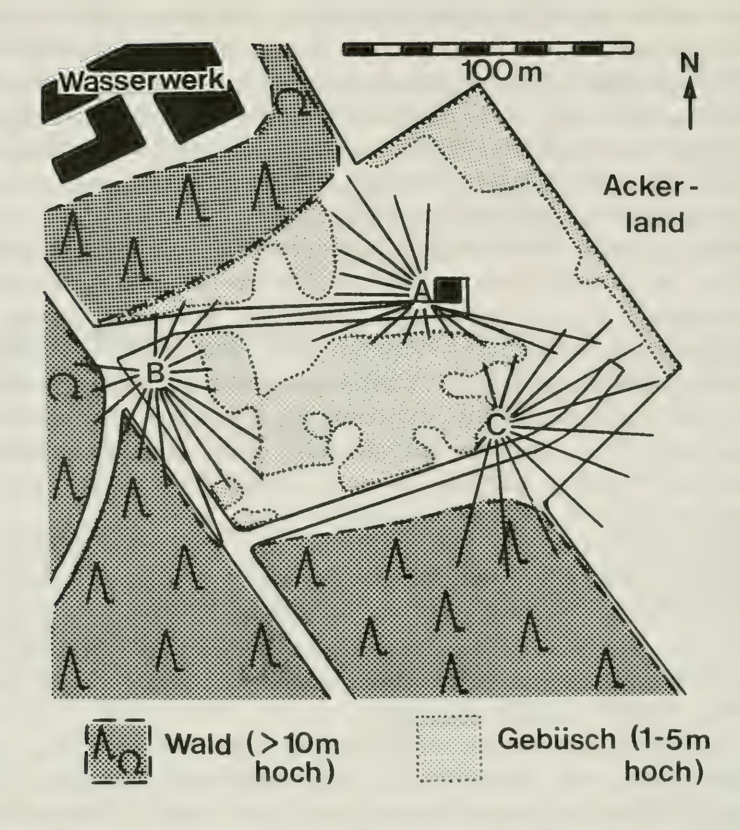


Abb. 2: Das Wasserwerksgelände Oberschleißheim mit den Fangplätzen "WaN" (=A), "WNw" (=B) und "WNo" (=C).
The localities "WaN" (A), "WNw" (B) and "WNo" (C); dark grey = wood (trees over 10 m), grey = shrubs (1-5 m).

- Das Mallertshofer Holz im Nordosten ("M"), stellt einen Ausläufer des Kiefern-Eichenwaldgürtels dar. Für die vorliegende Untersuchung wichtige Teilflächen dieses Gürtels sind der Berglwald ("B") im Norden, das Schweitzerholz ("S") im Osten und das Korbinianiholz ("K") im Süden.

<u>Halbtrockenrasen</u>
Der Charakter des Trespen-Halbtrockenrasens (*Mesobrometum erecti*) ist auf dem Flughafengelände (ca. 3,5 km^2) im Süden des Siedlungsgebietes nicht eindeutig ausgeprägt. Durch die extensive, nicht allzuhäufige Beweidung durch Schafe werden Pflanzenarten, die von den Schafen gemieden werden (z.B. Gemeine Schafgarbe, die an den meisten Stellen sehr häufig ist), bevorzugt. Eine Entwicklung zu einem Enzian-Zwenkenrasen (*Gentiano-Koelerietum pyramidatae*) hat jedoch bisher nicht stattgefunden.

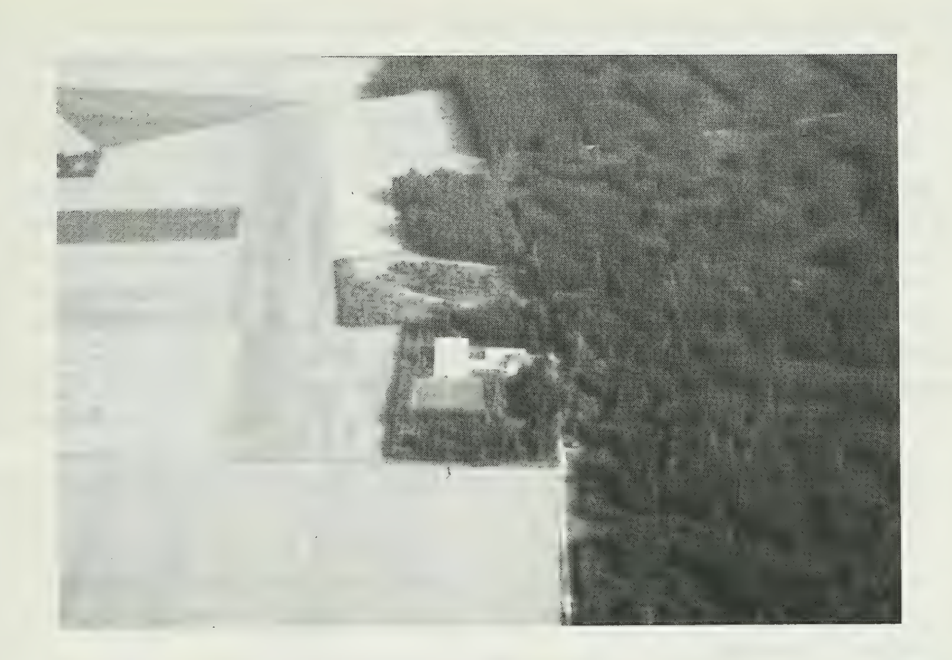


Abb. 2b: Luftbild des Wasserwerksgeländes Oberschleißheim (Freigabe Reg. v. Obb. GS 300/91 75/82.



Abb. 2c: Blick vom Fangplatz "WNw" nach "WaN" im Wasserwerksgelände Oberschleißheim.

- Halbtrockenrasen (Nord-)Ost ("HO"): Der Fangplatz befindet sich an der Stelle, wo das Schweitzerholz und der Schloßpark (hier Stiel-Eiche als dominante Art) aneinandergrenzen in einer kleinen Einbuchtung des Halbtrockenrasen-Gebietes. Der Waldcharakter ist hier noch deutlich ausgeprägt. Durch die Randlage kommt es zu einem großen Arten- und Strukturreichtum der Vegetation.
- Halbtrockenrasen Mitte ("HM"): Der Standort ist durch reinen Offenlandcharakter bestimmt, zur Ausprägung des Trespen-Halbtrockenrasens siehe obige Bemerkungen. Der Rand des Flughafengebiets ist in allen Richtungen ungefähr 800-1000 m entfernt.
  In ca. 150-300 m Entfernung befindet sich eine ca. 5 ha große ruderalartige Fläche ("R") mit 5-10 m hohen Weiden, Rainfarn-Beifuß-Gestrüpp (*Tanaceto vulgaris-Artemisietum vulgaris*) sowie Großer Brennessel (*Urtica dioica*), Schilfrohr (*Phragmites communis*) und Land-Reitgras (*Calamagrostis epigejos*) als weitere häufige Pflanzenarten.
  Das im Südosten liegende Drittel des Flughafengebiets wird teilweise intensiv landwirtschaftlich genutzt.
  Am Flughafen-Nordrand befindet sich in ca. 800 m Entfernung ein neuentstandener Teich mit Teichröhricht (*Scirpo-Phragmitetum*), Natternkopf-Steinklee-Gesellschaften (*Echio vulgaris-Melilotetum*) und einer Reihe von Pionierpflanzen in der näheren Umgebung.
- Halbtrockenrasen West ("HW"): Am Westrand des Halbtrockenrasengebiets wurde an einem offen strukturierten Standort gefangen, in dessen unmittelbaren Umgebung vereinzelt 1-2 m hohes Gebüsch und junge Bäumchen verschiedenster Arten angepflanzt wurden.
  In ca. 150 m Entfernung befindet sich der Würmkanal mit kleineren auwaldartigen Baumbeständen. Die Sicht zur Lichtquelle war von dort durch ein 10 m hohes Gebäude versperrt.

<u>Dachauer Moos</u>

- Würmauen ("Au"): Eine auwaldartige Begleitflora, durchsetzt von jahrhundertealten Baumveteranen (siehe HAUSMANN, 1987) stellt zusammen mit einem an manchen Stellen ausgeprägten Brennessel-Giersch-Saum (*Urtico dioicae-Aegopodietum*) typische Aspekte der Vegetation dieses Lebensraumes, der an der Fangstelle von Ackerland begrenzt ist, dar.
- Weiher im Torfeinfang ("We"): Der Torfeinfang ("T") ist ein Relikt ehemals ausgedehnterer "minerotropher Erlenbrücher" (*Alnetalia glutinosae*), die von den Beständen der Moorbirke (*Betula pubescens*) beherrscht werden. Am Fangplatz sind weiterhin Brennessel-Giersch-Saum (*Urtico dioicae-Aegopodietum*) und Teichröhricht (*Scirpo-Phragmitetum*) wichtige Pflanzenassoziationen.
- Birket: Moorbirkenwald ("Mb"): Das Birket ist ein dem Torfeinfang recht ähnlicher Standort. Die Größe des relativ isolierten Wäldchens beträgt 16,9 ha.
- Franzosenhölzl ("F"): In seiner Vegetation entspricht dieses ebenfalls isoliert liegende Moorbirkenwäldchen den beiden vorhergehend beschriebenen Standorten.
- Moorversuchsgut ("Mo"): Der Fallenstandort befindet sich auf einer kleinen Wirtschaftswiese, die an dieser Stelle von Brennessel-Giersch-Saum (*Urtico dioicae-Aegopodietum*) begrenzt wird. In ca. 70 m Entfernung befinden sich 2 Entwässerungskanäle, deren Vegetation als "Moorgebüsch" (*Frangulo-Salicion auritae*)

bezeichnet werden könnte und von Weiden (*Salix*) dominiert wird. Einen ähnlichen Charakter besitzt ein anderer Entwässerungsgraben ("E") zwischen dem Birket und dem Franzosenhölzl, von dem einige Beobachtungen stammen.

2.3. KLIMADATEN UND WETTER

Im langjährigen Mittel treten im Siedlungsgebiet Oberschleißheim Niederschlags-Jahressummen von 814 mm auf, in Badersfeld (500 m vom Birket entfernt) sind es 844 mm. Das Temperaturmittel beträgt für Schleißheim 7,5 °C (Deutscher Wetterdienst/Wetteramt München, briefl.).
Insgesamt betrachtet dürften beide Fangjahre als durchschnittlich bis gut einzustufen sein, was die Individuen- und Artenausbeute betrifft. Vergleichsweise katastrophal wirkte sich jedoch die naßkalte Witterung von April bis Juni 1987 auf die Nachtfalteraktivitäten aus.

3. METHODE

3.1. FANG

3.1.1. Lebend-Lichtfang

Bei der repräsentativen Erfassung von Nachtfalter-Zönosen stellt die nächtliche Lebensweise einen Unsicherheitsfaktor dar. Durch moderne Methoden, vor allem durch verbesserte Produkte der Beleuchtungsindustrie (z.B. UV-Röhren) konnten seit der Jahrhundertwende gerade in der wichtigsten Methode, dem Lichtfang, entscheidende Fortschritte erzielt werden.
Die "klassische" Methode besteht darin, an einem angestrahlten Tuch in Anwesenheit des Beobachters die anfliegenden Tiere zu registrieren.
Moderne Lebend-Lichtfallen bieten dagegen bei Fragestellungen wie im vorliegenden Fall eine Reihe von entscheidenden Vorteilen:

- Die mit UV-Röhren bestückten Fallen verbrauchen wenig Strom und sind daher vom Stromnetz ohne aufwendige Apparatur (Aggregat) potentiell unabhängig.
- Der Beobachter wird nicht der schädlichen Strahlung ausgesetzt.
- Das Fangergebnis ist in gewissen Grenzen quantitativ auswertbar ("relative Häufigkeiten"). Nach RETZBANYAI-RESER (1974) muß "die moderne faunistische Forschung unbedingt auch quantitativ sein".
- Ein Parallelfang gleichzeitig mit mehreren Fallen ist durch einen Beobachter möglich.
- Die Methode ist konstant, so gut wie unabhängig vom Beobachter und in gewissen Grenzen standardisierbar.

Einige Nachteile werden noch erörtert werden, diese können jedoch durch entsprechende Maßnahmen auf ein Minimum reduziert werden.

Für die Parallelfänge wurden drei <u>identisch</u> gebaute Lichtfallen vom Minnesota-Typ verwendet. Sie waren nach dem in REICHHOLF (1984) beschriebenen Prinzip konstruiert und mit 18-W Schwarzlichtröhren (Maximum der relativen Leuchtstärke bei 360-370 nm) bestückt. Die Unversehrtheit der gefangenen Falter wurde durch Verschlupfmöglichkeiten (Eierschachteln) und Regenschutz sowie durch einige in Kapitel 3.2. erwähnte Maßnahmen gewährleistet.

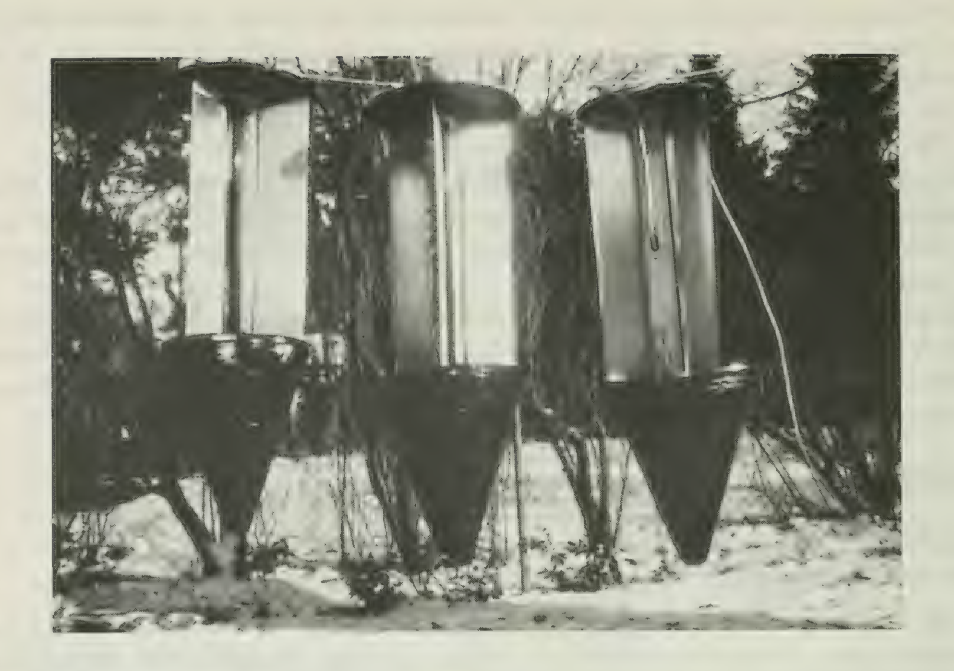


Abb. 2d: Lebendlichtfallen.



Abb. 2e: Die Lebendlichtfalle am Fangplatz "WaN" bei Sonnenaufgang. Die Auswertung des Fangs an dieser Stelle war zum Zeitpunkt der Aufnahme bereits abgeschlossen.

Im Juli 1987 und von Juni bis August 1988 wurden zu Ergänzungsfängen teilweise noch zwei weitere Fallen eingesetzt.
Eine der drei "Hauptfallen" wird von einer Autobatterie gespeist, die beiden anderen arbeiten mit Netzstrom. Um die Konstanz der Methode zu gewährleisten, wurde getestet, ob die Fangergebnisse der verschiedenen Fallen gleich waren. Hierzu wurden sie im Flughafengebiet, wo an allen drei Standorten Netzstrom zu Verfügung stand, im "Rotationsprinzip" jeweils durchgewechselt und die Verhältnisse der Individuen- bzw. der Artenzahlen zu den beiden anderen Fallen ermittelt. Das Ergebnis zeigte eine Drosselung der Individuen- und Artenausbeute bei der batteriebetriebenen Falle auf ca. 60 %. Dieses Manko wurde im Flughafengebiet und im Wasserwerk durch das erwähnte Rotieren-Lassen ausgeglichen, an den Standorten SiS, WaM, Au, We und Mb ist bei Vergleichen ein entsprechender Korrekturfaktor zu veranschlagen.

3.1.2. Andere Methodiken

Mit Lichtfang allein kann man kein 100prozentiges Nachtfalter-Artenspektrum erfassen. Dies hat seinen Grund darin, daß es nachtaktive Arten gibt, die Lichtquellen nicht oder nur mit äußerst geringer Affinität anfliegen. Hierher gehören beispielsweise viele Arten der Gattungen *Cucullia* und *Catocala* (*Noctuidae*). Manche Arten reagieren zwar auf das Licht, fliegen die Lichtquelle jedoch nicht direkt an, so daß sie, wie manche Flechtenbären (*Nolidae*), in Lichtfallen relativ selten erfaßt werden. Andere sind obligatorische Tag- oder Dämmerungsflieger geworden, wie die Eulenfalter (*Noctuidae*) *Ectypa glyphica* und *Callistege mi*, die Spanner (*Geometridae*) *Archiearis parthenias* und *Odezia atrata* sowie die meisten Sackträger (*Psychidae*) und Glasflügler (*Aegeriidae*). Ca. 5 % des Artenspektrums der Macroheteroceren dürfte in die bisher besprochenen Kategorien fallen.
Andere Arten fliegen tagsüber und mehr oder wenig häufig auch nachts, z.B. die Wanderfalter *Autographa gamma*, *Chloridea viriplaca* und *Macroglossum stellatarum* (letzterer am Licht nur selten), aber auch *Diacrisia sannio*, *Eustrotia olivana*, *Jaspidia deceptoria*, *Phytometra viridaria*, *Hypena proboscidalis*, *Epirrhoe tristata*, *E. alternata*, *Chiasmia clathrata*, *Ematurga atomaria*, *Siona lineata* und einige weitere. Es handelt sich hierbei ebenfalls um ca. 5 % des Artenspektrums.
Die Affinität zum Licht ist von Art zu Art, bei vielen Arten auch geschlechtsdifferenziert verschieden, was beim Versuch einer Quantifizierung der Ergebnisse zu berücksichtigen ist.

Was kann also getan werden, um für faunistische Fragestellungen die Erfassung des Artenspektrums zu optimieren?

Bezüglich der Tagflieger sind regelmäßige Tagexkursionen erforderlich. Diese wurden im Untersuchungsgebiet in den letzten 15 Jahren jeweils 50-100mal pro Jahr bei einem Zeitaufwand von 1-3 Stunden in den verschiedenen Biotopen durchgeführt. Zusätzlich war bei der Installation der Lichtfang-Apparatur natürlich auch die Umgebung Ziel der Aufmerksamkeit. In der Dämmerung schwärmende Falter wurden desöfteren mit dem Käscher gefangen. Dies bringt vor allem im Frühsommer an blütenreichen Feldhecken und Waldrändern oft erstaunliche Ausbeuten an Spannerarten (*Geometridae*).
Bei den Exkursionen wurden auch Präimaginalstadien gesammelt. *Cucullia verbasci* ist beispielsweise im Raupenstadium in Oberschleißheim stets häufig, am Licht konnten

bisher jedoch noch keine Imagines beobachtet werden. Ähnlich wird dies auch bei vielen Psychiden und einigen anderen Taxa die Hauptmethodik sein, Artnachweise zu "landen".
Köderfang erfolgte nur einige Male (ca. 20), meist mit schlechtem Erfolg (siehe URBAHN, 1973). Hierbei war keine einzige Art zu "erbeuten", die nicht auch irgendwann ans Licht gekommen wäre.

3.2. FANGMODUS

Die letztgenannten Methodiken sollten Zusatzinformationen zur Vervollständigung der einzelnen Artenspektren sammeln, um zu testen, ob in bestimmten Fällen apparente Austauschprozesse von Jahr zu Jahr (turnover) in den Lichtfallen-Artenspektren nur methodisch-bedingter Natur waren.
Um mit Hilfe der Lebend-Lichtfänge, die die Hauptgrundlage für die vorliegende Arbeit darstellen, in bezug auf die Fragestellungen verwertbare Informationen zu erhalten, ist ein bestimmtes Muster in der angewendeten Methodik vonnöten. Dieses läßt sich nach folgenden Kriterien gliedern:
1. Ökologie (Abdeckung verschiedener Habitate, Habitattypen)
2. Raum ("Fangstellennetz", verschiedene Distanzen)
3. Zeit (Fangnacht-Abstände)
4. Zusätzliche Experimente (Markierung)

3.2.1. Ökologie

Das Gebiet von Oberschleißheim wurde - generalisierend - in folgende vier "Haupt-Biotoptypen" eingeteilt:
Siedlungsgebiet / Wald / Offenland (Halbtrockenrasen) / landwirtschaftlich genutztes Dachauer Moos (siehe "Untersuchungsgebiet", Kapitel 2).
Es sollte, wo möglich, das Verbreitungszentrum der Arten ermittelt werden, um sie in Einzelfällen an anderen Standorten als zugeflogene Gastarten einstufen zu können. Hierzu war natürlich eine besondere Berücksichtigung der Larvalökologie nötig, um eine zahlenmäßig geringe aber bodenständige Anwesenheit einer Art aufgrund suboptimaler Bedingungen von solchen Dispersionsereignissen abtrennen zu können.

3.2.2. Raum

Es wurde jeweils mit drei identisch gebauten Lebend-Lichtfallen in derselben Nacht parallel gefangen. Die drei parallel kombinierten Fangplätze blieben pro Jahr konstant dieselben und lagen im gleichen Haupt-Biotoptyp.
So wurden 1987 jeweils drei Standorte im Flughafengebiet, im Berglwald und im Siedlungsbereich miteinander kombiniert. Im Birket (Mb) wurde zusätzlich gefangen, um Verbreitungsschwerpunkte eventueller Zuflieger zu ermitteln, der Fang erfolgte hier nicht über das Jahr hinweg parallel zu anderen Fangplätzen. Die Fallenabstände betrugen bei den Parallelfängen 0,5-2,0 km. Die Maximal- (Mb/HO) und Minimalabstände (SiN/WaS) lagen bei 4,9 km bzw. 30 m.

1988 sollte durch eine Beibehaltung der Methode im Flughafengebiet ein Vergleich der Jahre 1987/1988 ermöglicht werden. Am Nordrand des Waldes wurden die Fallendistanzen um ca. eine Zehnerpotenz verringert (siehe Untersuchungsgebiet, Kapitel 2). Im Siedlungsbereich erfolgte der Fang nur im Garten des Verfassers (SiN, WaS), meist kombiniert mit den beiden anderen Standorten im Torfeinfang (We) und am Würmkanal (Au).
Die durch dieses Netz "abgedeckte Fläche" (jedoch ohne vollständige Erfassung aller Biotope!) beträgt ca. 6 km^2, wenn man einmal die Standorte im Dachauer Moos unberücksichtigt läßt. In einzelnen Fällen sind nicht erfaßte Häufigkeits-Peaks oder sogar zusätzliche Arten in dazwischenliegenden Biotopen außerhalb der Reichweite der Lichtquellen zu erwarten (wohl v.a. im Bereich des Schloßparks).
Teilweise wurden auch Fangergebnisse aus den über 1000 Fängen der anderen Jahre (1974-1986, 1989) berücksichtigt, von besonderem Interesse sind hierbei die an HO und HM 1986 durchgeführten Parallelfänge.

3.2.3. Zeit

BETTMANN (1985a; 1985b; 1986) stützte seine Auswertungen auf Markierungs/Wiederfang-Versuche bei teilweise täglichem Lichtfang an einem definierten Standort, was von verschiedener Seite kritisiert wurde (z.B. RETZBAYAI-RESER, 1980).
Um nicht zu stark in das Dispersionsgeschehen einzugreifen und den Tieren die Möglichkeit zu geben, wegzufliegen, ohne in der darauffolgenden Nacht gleich wieder im Bann der Lichtquelle gefangengehalten zu werden (bzw. nach anderen Theorien: "vom Licht geblendet zu werden", siehe SCHACHT & WITT, 1986), wurde ein Fang an derselben Stelle in zwei aufeinanderfolgenden Nächten vermieden. Eine Ausnahme wurde 1988 im Garten (WaS) gemacht (siehe II. Teil, "Vorstellung der Markierungsexperimente", Kapitel 8.1.).
Die Anzahl der Fänge pro Monat verteilte sich nur im Garten und Wasserwerk 1988 im zweitägigen Rhythmus (vereinzelt Intervalle von 3 Tagen) gleichmäßig über das Jahr, sie richtete sich ansonsten nach der schwerpunktmäßigen Verbreitung der Arten auf die in den Markierungsexperimenten gezielt wurde. So wurde z.B. im Juni verstärkt am Flughafen gefangen, wo in diesem Monat *Pachetra sagittigera, Leucania comma, Apamea sublustris* und viele andere typische Falter offener, trockener Wiesen häufig sind.
Die 1438 Fangnächte in den Jahren 1987 und 1988 verteilten sich folgendermaßen auf die verschiedenen Monate:

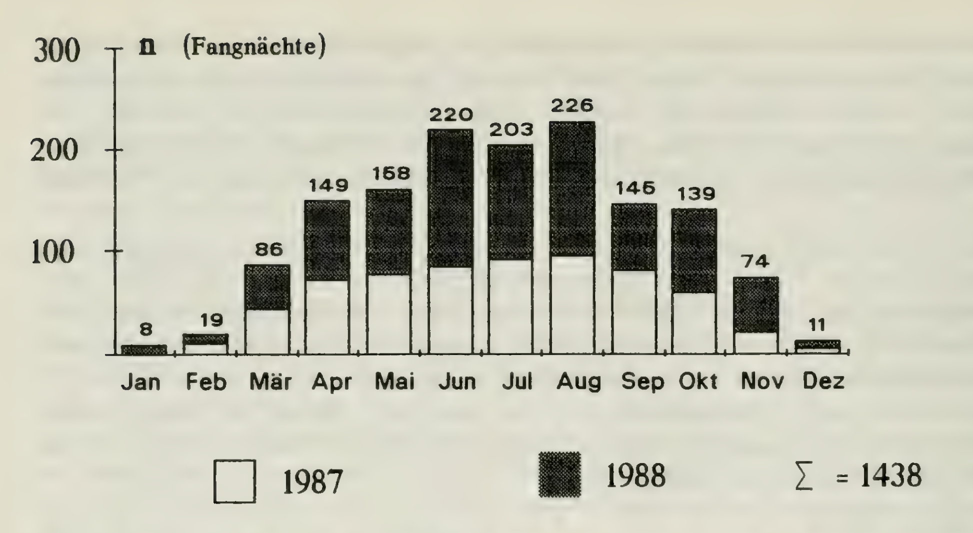


Abb. 3: Verteilung der 1438 Lichtfänge auf die verschiedenen Monate der beiden Erfassungsjahre 1987 und 1988.
Distribution of the 1438 light-trap-captures over the months from January to Dezember 1987 and 1988.

3.2.4. Zusätzliche Experimente

In einigen zusätzlichen Experimenten sollte anhand markierter Nachtfalter versucht werden, weitere Aufschlüsse über Dispersionsverhalten und Austauschprozesse in Nachtfalterpopulationen zu erhalten. Hierbei wurde jeweils mit besonderem Fangmodus gearbeitet.

3.3. AUSWERTUNG

Die jeweils von Sonnenuntergang bis Sonnenaufgang betriebenen Fallen wurden noch vor der Morgendämmerung aufgesucht, verschlossen, an einen kühlen, schattigen Ort gebracht und an den heißesten Tagen im Hochsommer bisweilen auch mit etwas Eis gekühlt, da sich in Spitzenflugnächten die Auswertung bis in den Vormittag hinein erstreckte, obwohl sie bereits gegen 3.^{oo} am Morgen begonnen wurde. Die frühe Auswertung ist ratsam, um Verluste durch Vögel zu vermeiden und eine Schädigung der Falter durch unnötig lange Gefangenschaft und Austrocknung zu verhindern. Zur Beschleunigung des Vorgangs halfen in der Hauptflugzeit desöfteren mein Vater Stefan, meine Frau Silvia und meine Schwester Susanne Hausmann durch die Übernahme der Schreibarbeiten.
Die in der Umgebung um die Falle herum sitzenden Falter wurden getrennt notiert, bei den Auswertungen jedoch zum Fangergebnis gerechnet. Beim Öffnen der Falle wurde mit größter Sorgfalt gearbeitet, so daß nur einzelne Tiere vor der Registrierung fliehen konnten.

Die Artbestimmung erfolgte im Freiland nach den Bestimmungswerken KOCHs (1984) und FORSTER & WOHLFAHRT (1955-1981). Bei markierten sowie bei offensichtlich biotopfremden Tieren wurde auch das Geschlecht ermittelt.

Im Zuge einer fotographischen Dokumentation des Fangergebnisses entstanden in den letzten 10 Jahren über 10.000 Fotos; in besonderen Fällen erschien es ratsam, Belegexemplare in die Zoologische Staatssammlung München zu geben.
Ca. 80-90 % der im Untersuchungsgebiet vorkommenden Arten konnten an der Fangstelle determiniert werden. Bei einigen (artenmäßig vergleichsweise wenigen) problematischen Arten mußten zusätzliche Differenzialmerkmale wie Fühlerbau oder (v.a.) die Struktur der Genitalapparaturen untersucht werden. Letzteres wurde bei den Gattungen *Mesapamea, Amphipoea* (1987) und vielen Arten der Gattung *Eupithecia* obligatorisch durchgeführt, bei einer Reihe weiterer Gattungen wie z.B. *Oligia, Hydraecia* oder *Oporinia* geschah dies in größerem Ausmaß. So wurden in den beiden Untersuchungsjahren zur Absicherung der Determination über 1000 Genitalpräparate angefertigt, davon über die Hälfte aus der Gattung *Eupithecia*.
Das Freilassen der Tiere erfolgte in einem Radius von 5-10 m um die Falle herum an möglichst vielen verschiedenen Stellen in dichter und hoher Vegetation, auch dies, um Verluste durch Vögel zu vermeiden.

3.4. MARKIERUNG

Zur Markierung der Falter wurden im Handel erhältliche Fingernagellack-Farben verwendet, bei der Auswahl der 20 verschiedenen Farben wurde darauf geachtet, daß sie auch nach dem Trocknen noch gut unterscheidbar waren; gleichzeitig sollten sie nicht zu auffällig sein, um eine höhere Mortalität durch Vögel und andere Feinde zu verhindern.
Von den beiden bei der Erstmarkierung aufgetragenen Punkten codierte der eine den Fangplatz, der andere das Fangdatum.
Hierzu wurde der Thorax des Falters vorsichtig von Haaren und Schuppen freigepinselt, danach wurde die Farbe in Punkten von ca. 1 mm Durchmesser mit einem vorher präparierten Pinselchen auf den Thorax aufgetragen, wobei darauf zu achten war, mit dem Lack nicht in die Tergit-Fugen zu geraten, z.T. wurde zusätzlich ein "Sicherheitspunkt" auf dem Flügel angebracht. Einige kleinere Arten, vor allem Spanner (*Geometridae*) konnten aus Platzgründen nur auf den Flügeln markiert werden.
Bei Wiederfängen wurde die den Tag codierende Farbe im Wurzelfeld des Flügels angebracht, ab dem Zweitwiederfang waren die Tiere dann meist individuell erkennbar und bedurften keiner weiteren Kennzeichnung.
Es zeigte sich, daß diese etwas kompliziert klingende Methodik bei einiger Übung eine gute und rasche Markierung von Nachtfaltern zuließ: Von 23.492 markierten Faltern mußten nur 17 wegen vermutlicher Schäden oder Behinderungen der Flugfähigkeit aus der Wertung genommen werden.

Drei Fehlerquellen seien hier noch kurz besprochen:

- Obwohl die Farbe schnell trocknet, könnte es durch ein Abwischen beider Punkte zu fehlerhaften Ergebnissen kommen. Der Anteil solcher Exemplare mit "Glatze" betrug jedoch in den verwendeten Lichtfallen je nach Witterung ca. 2-5 %. Dieser Prozentsatz war bei Arten, die nicht markiert wurden, genauso hoch. Eine bevorzugte "Glatzenbildung" bei markierten Tieren durch Abwischen der Farbe fand also nicht statt. Es ist also nur eine sehr geringfügige Unterschätzung der Wiederfang-Quoten zu veranschlagen.

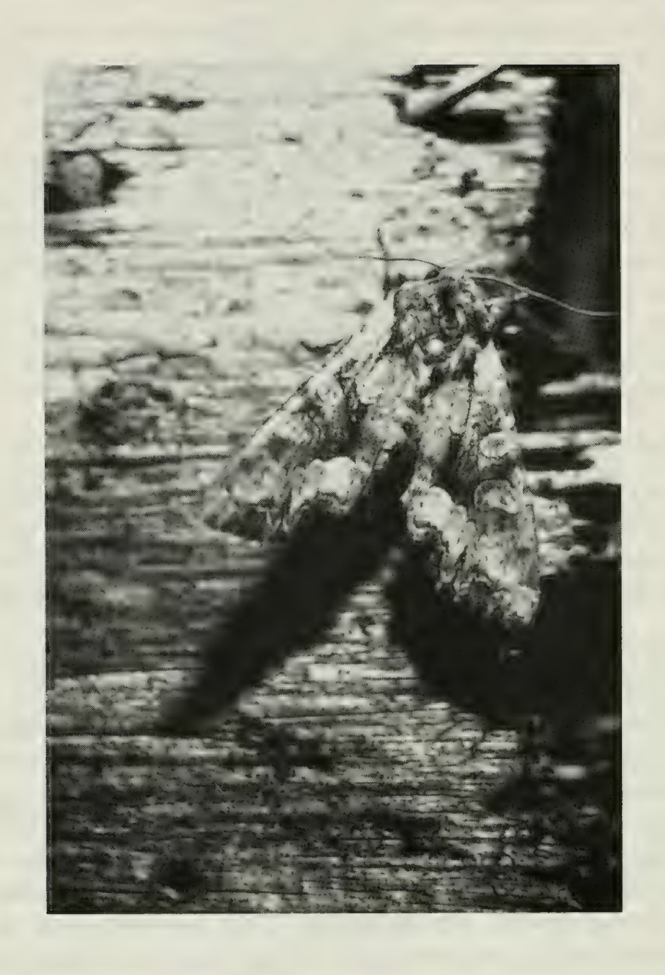


Abb. 3b: Mamestra w-latinum (♂, HW, 16.6.87) mit zwei verschiedenfarbigen Markierungspunkten auf dem Thorax.

- Verluste bzw. Beeinträchtigungen durch den Fangvorgang sind vermutlich zu vernachlässigen: Einige Falter wurden 8-10mal gefangen und waren dennoch am Ende in noch erstaunlich gutem Zustand.
- Verluste bzw. Beeinträchtigungen durch den Markierungsvorgang sind vermutlich ebenfalls zu vernachlässigen: Ein erster Hinweis darauf ist die eben erwähnte Beobachtung. Weiterhin konnte dreimal beobachtet werden, wie markierte Falter eine Kopula eingingen. Schließlich wurden einige markierte Falter (je 3 Noctuiden- und Geometridenarten sowie eine Arctiide) in Gefangenschaft bei Fütterung gehalten und die Überlebensdauern von 1-2 Wochen, in einem Fall von 16 Tagen zeigen, daß diese Freilandfalter, die vor dem Anfliegen der Lichtfalle vielleicht schon einige Tage alt waren, eine normale Lebenserwartung hatten. Ein ♀ legte dabei seinen Eivorrat ab.

3.5. MATERIAL

Folgende Werte stellen die Eckdaten für das 1987 und 1988 mit der Methodik des Lebend-Lichtfangs gesammelte Material dar:

49.072 Individuen (*Macroheterocera*)

462 Macroheteroceren-Arten (zusammen mit den Tagbeobachtungen und den Meldungen aus den anderen Jahren: 514 Arten)

23.434 markierte Individuen (1989 384 weitere)

1290 Wiederfänge (1989 57 weitere)

Aus Tabelle 1 wird die Verteilung der gefangenen Individuen auf die verschiedenen Monate des Jahres ersichtlich, in der Hauptflugzeit von Mitte Juni (11.6.) bis Ende August flogen 81,6 % aller in den Lichtfallen ausgezählten Nachtfalter (*Macroheterocera*).

Tab. 1: Verteilung der Individuen-Monatssummen in den Erhebungsjahren 1987 und 1988.
Distribution of the individuals over the months from January to Dezember 1987 and 1988.

Monat	Jan	Feb	März	Apr	Mai	Juni	Juli	Aug	Sep	Okt	Nov	Dez
Individuen-Σ	-	1	309	2181	1836	9615	18.039	14.258	1764	643	458	6

4. ARTENLISTE

4.1. VORBEMERKUNGEN

Die Unterscheidung zwischen "*Macro*-" und "*Microlepidoptera*" entstand aus mehr ästhetischen Beweggründen der Sammler, die die kleineren "Motten" verschmähten. Diese Einteilung entbehrt jedoch einer Grundlage in der Systematik. Einige üblicherweise zu den "Großschmetterlingen" gezählte Familien, z.B. *Hepialidae* oder *Psychidae* müßten bei genauerer Betrachtung der Verwandtschaftsverhältnisse ins System nahe bei Schmetterlingfamilien gestellt werden, die zu den "*Microlepidoptera*" gehören. Dennoch soll hier auf diese gängige Einteilung zurückgegriffen werden.
Hauptgegenstand der Untersuchung sind, wie erwähnt, die "*Macroheterocera*", worunter alle "Großschmetterlinge" mit Ausnahme der Tagfalter ("*Rhopalocera*") verstanden werden. Die überwiegend tagaktiven Widderchen (*Zygaenidae*), Sackträger (*Psychidae*) und

Glasflügler (*Aegeriidae*) werden in Lichtfallen so gut wie nie erfaßt und werden daher bei vielen der folgenden Auswertungen ausgeklammert. Die so eingegrenzte Gruppe von Schmetterlingen bezeichnet MEINECKE (1984) als "überwiegend nachtaktive Großschmetterlingsfamilien".

Die in der vorliegenden Untersuchung verwendete Nomenklatur und Systematik richtet sich aus Praktikabilitätsgründen nach FORSTER & WOHLFAHRT (1955; 1960; 1971; 1981), da dieses Werk allgemein gebräuchlich ist. Neuere Erkenntnisse der Taxonomie (z.B. LERAUT, 1980) sollen dadurch jedoch nicht in Frage gestellt werden. Lediglich bei den Psychiden wurde einer moderneren Systematik gefolgt und beispielsweise die früher zu den "*Microlepidoptera*" gerechnete *Narycia monilifera* mitaufgenommen.

4.2. TAGFALTER (*RHOPALOCERA*)

Tab. 2: Im Untersuchungsgebiet 1974-1989 festgestellte Tagfalterarten (Legende/Häufigkeit siehe Nachtfalterliste).
Species of Butterflies, recorded 1974-1989 in Oberschleißheim (Southern Bavaria).

Nr.	Art	Häufigkeit
1	Papilio machaon L.	n-h
2	Pieris brassicae L.	h
3	Pieris rapae L.	h
4	Pieris napi L.	h-sh
5	Anthocharis cardamines L.	h
6	Gonepteryx rhamni L.	sh
7	Colias hyale L.	h
8	Colias australis Vrty.	v
9	Erebia medusa Schiff.	h
10	Melanargia galathea L.	sh
11	Aphantopus hyperantus L.	sh
12	Pararge aegeria L.	n-h
13	Lasiommata maera L.	h
14	Lopinga achine Scop.	n-h
15	Maniola jurtina L.	sh
16	Coenonympha glycerion Bkh.	n
17	Coenonympha arcania L.	h-sh
18	Coenonympha pamphilus L.	sh
19	Apatura iris L.	n
20	Limenitis camilla L.	n
21	Vanessa atalanta L.	h
22	Vanessa cardui L.	n-sh
23	Aglais urticae L.	sh
24	Inachis io L.	sh
25	Nymphalis polychloros L.	1
26	Polygonia c-album L.	h
27	Araschnia levana L.	sh
28	Mesoacidalia aglaja L.	n
29	Argynnis paphia L.	sh
30	Brenthis ino Rott.	1
31	Clossiana selene Schiff.	sh
32	Clossiana euphrosyne L.	n-h
33	Clossiana dia L.	n-h
34	Issoria lathonia	h
35	Thecla betulae L.	n
36	Nordmannia ilicis Esp.	n
37	Strymonidia w-album Knoch	2
38	Strymonidia pruni L.	1
39	Callophrys rubi L.	n-h
40	Lycaena phlaeas L.	n
41	Cupido minimus Fuessly	n
42	Celastrina argiolus L.	1
43	Lycaeides idas L.	h (lokal)
44	Plebejus argus L.	2
45	Aricia agestis Schiff.	n
46	Cyaniris semiargus Rott.	n
47	Polyommatus icarus Rott.	sh
48	Lysandra bellargus Rott.	n
49	Lysandra coridon Poda	h
50	Erynnis tages L.	n
51	Pyrgus malvae L.	h
52	Pyrgus alveus Hbn.	2
53	Spialia sertorius Hffmgg.	2
54	Carterocephalus palaemon Pallas	h-sh
55	Adopaea lineola O.	n-h
56	Adopaea sylvestris Poda	n
57	Ochlodes venatus Bremer & Grey	sh
58	Hesperia comma L.	n

Aus Gründen der Vollständigkeit wird diese Großschmetterlingsgruppe, die eigentlich nicht Gegenstand der Untersuchung ist, hier kurz aufgeführt. Bei einigen ökologischen Mustern kann das Aufzeigen von Parallelen zu den Tagfaltern angebracht sein.
Die Tagfalterhäufigkeiten beziehen sich auf die addierten Jahressummen des ganzen Untersuchungsgebietes und sind daher in dieser Form sehr verallgemeinernd dargestellt.

4.3. NACHTFALTER (*MACROHETEROCERA*)

In der Nachtfalterliste kam es ab dem 28.5.1988 am Fangplatz "WaS" aus zwei Gründen zu einer bisweilen starken Überhöhung der Werte: Durch (methodisch bedingte) Wiederfänge sind durchschnittlich 18 % bei den betreffenden Arten zu veranschlagen. In besonders krassen Fällen (>50%) wurden die Werte besonders ("mÜ") gekennzeichnet. Eine Überhöhung im Vergleich mit dem Fangplatz SiN erfolgte zusätzlich durch häufigeren Fang, das Ausmaß wird zumindest bei den in größerem Umfang markierten Arten im II. Teil (Kapitel 9.2.) aus den Markierungstabellen ersichtlich. So ergibt sich beispielsweise bei *Mythimna impura* aus einem SiN/WaS-Verhältnis von 4/32 nach der Bereinigung ein Wert von 4/11, bei *Lymantria monacha* statt 2/11 nur 2/6 und bei *Arctia caja* statt 2/13 sogar ein umgekehrtes Verhältnis von 2/1, bedingt durch ein an WaS 10mal gefangenes ♂.

Einige besonders gekennzeichnete Nachweise stammen aus einer Bestandserhebung 1988 im Korbinianiholz (KOLBECK, in Vorber.).

Die Angaben zur Ökologie sind nur als eine approximative und vorläufige Charakterisierung der Verhältnisse im Untersuchungsgebiet zu verstehen. Es wurden hierbei ausgehend von den Beschreibungen BERGMANNs (1951-1954), KOCHs (1984), GERSTBERGER & STIESYs (1983) und REJMANEK & SPITZERs (1982) nach einer wegen der Frage der geographischen Vergleichbarkeit sehr kritischen Betrachtung der Literaturangaben die im Untersuchungsgebiet gemachten Beobachtungen interpretiert. Die Übertragbarkeit dieser Aussagen auf andere Gebiete kann, wenn überhaupt, jeweils erst nach einer Überprüfung konstatiert werden, da oft ein und dieselbe Art in verschiedenen Höhenstufen, in verschiedenen Breitenlagen u.s.w. unterschiedliche ökologische Anpassungen zeigt.
Eine Schwierigkeit stellt auch der Umstand dar, daß die Einnischung verschiedener Arten oft von ganz unterschiedlichen Faktoren abhängt: Manchmal richten sie sich nach mikroklimatischen Verhältnissen (z.B. die starke Sonneneinstrahlung bei polyphagen Arten, die sowohl auf Heiden wie auch in Mooren vorkommen), oder sie ist fast nur durch die Raupenfutterpflanze bestimmt (viele monophage Arten).
Viele Arten sind recht euryök. Aus diesem Grunde erfolgte in den meisten Fällen die Angabe mehrerer möglicher Lebensräume, die jedoch als Anhaltspunkt stets auf ein Hauptvorkommen "präzisiert" wurde.

In der **Artenliste (Tab. 3)** werden folgende Abkürzungen und Symbole verwendet:

Legende/Fangplätze:

SiS = Siedlung Süd
SiM = Siedlung Mitte
SiN = Siedlung Nord (Garten vor dem Haus)
WaS = Wald Süd (Waldstreifen hinter dem Haus)
WaM = Wald Mitte
WaN = Wald/Wasserwerk Nord
WNw = Wald/Wasserwerk Nordwest
WNo = Wald/Wasserwerk Nordost
HO = Halbtrockenrasen (Nord-)Ost (Waldrand)
HM = Halbtrockenrasen Mitte (Offenland)
HW = Halbtrockenrasen West
Au = Auwald am Würmkanal
We = kleiner Weiher mit Moorbirkenwäldchen (Torfeinfang)
Mb = Moorbirkenwald (Birket) im Inneren

vor 1987:

Gar = Garten (1974-1986)
Mo = Moos zwischen zwei Entwässerungsgräben, 250 m vom Birket entfernt (1985)
HO = siehe oben (1986)
HM = siehe oben (1986)

weitere Fundorte:

Schw.holz = Schweitzerholz
Regattastr. = Ruderregattastrecke
Entw.graben = Entwässerungsgraben

Legende/Ökologie:

Ub = Ubiquisten
Wf = Wanderfalter
Wf(RR) = Wf nach RETZBANYAI-RESER (siehe Literaturverzeichnis)
mGr = Arten der mesophilen Graslandschaften
Agr = Arten der unter Agrarnutzung stehenden Flächen
Geb = mesophile Arten der Hecken, Gebüsche und der Waldränder
Geb/R = Geb, jedoch bevorzugt an ruderalartigen Standorten
W = mesophile Arten der Wälder
WL = Laub- und Mischwaldarten
WN = Nadel- und Mischwaldarten
Hy = Hygrophile Arten im weiteren Sinn
Xe = Xerothermophile Arten im weiteren Sinn

Legende/Häufigkeiten:

1-3 = unter 4 Individuen
v = vereinzelt
n = nicht selten
h = häufig
sh = sehr häufig

sonstige Abkürzungen:

E = Fund von Eiern/Eigelegen
R = Raupenfund
P = Fund von Puppen bzw. Kokons
♂♂ = Am Licht nur ♂♂
♀♀ = Am Licht nur ♀♀
Ex. = Exemplar
T = Imagines tag- bzw. dämmerungsaktiv, daher am Licht nicht optimal erfaßbar
Däm = (Abend-)Dämmerungsflieger / in der Dämmerung gekäschert
zus. = zusätzlich(e, er, es)
Gen.prp. = Genitalpräparat (nur in wichtigen Fällen angegeben)
am L. n. opt. = am Licht nicht optimal
F.F.w.r. = Fänge in der Flugzeit wenig repräsentativ
mÜ = methodisch bedingte Überhöhung der Werte

In der Nachtfalterliste bezieht sich jeweils die erste Zeile der ersten vier Spalten auf das Erhebungsjahr 1987, die zweite Zeile auf 1988.

Nr.	Art	SIEDLUNG SiS	SiM	Garten SiN	WALD WaS	WaM	Wasserwerk WaN	WNw	WNo	HALBTROKKENRASEN HO	HM	HW	"DACHMOOS" Au	We	Mb	VOR 1987 Gar	Mo	HO	HM	ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
Nolidae																						
59	Celama confusalis H.-S. 1847	-	-	- -	- 1	-	- -	-	-	- -	- -	- -	-	-	-	-	-	-	-	WL (Geb)	E4-A6	1989 ein zus Ex. im Korbinianiholz
Lymantriidae																						
60	Dasychira selenitica Esp. 1789	-	-	- -	- -	-	- -	-	-	- -	- -	- -	-	-	-	-	-	-	-	mGr (Geb)	E6	am 29.5.89 im Mallertshofer Holz ein ♀
61	Dasychira pudibunda L. 1758	-	-	- 1	1 2	1	1 -	3	1	3 10	1 -	3 1	-	1	7	v-n	-	16	1	WL (Geb)	M5-E6	
62	Orgyia recens Hbn. 1819	-	-	- -	- -	-	(E) -	2	-	- -	- 1	- 2	1	1	-	1	-	-	-	Ub (Geb)	A7-M8	♂♂, auch T, am L. n. opt., Birket 1983 E
63	Lymantria monacha L. 1758	-	-	6 2	3 11	18	22 12	27	7	13 16	- -	1 -	-	1	3	v-h	-	29	-	WN (Geb)	A7-A9	
64	Euproctis chrysorrhoea L. 1758	-	-	- -	- -	-	- -	-	-	- -	1 -	- -	-	-	-	-	-	-	-	WL (Geb)	M7-E7	S-Bahnhof 1987 1 Ex.
65	Porthesia similis Fuessly 1775	-	-	- -	- -	-	- -	-	1	- -	- -	1 -	1	26	109	-	6	-	-	WL (Hy, Geb)	A7-M8	
Arctiidae																						
66	Cybosia mesomella L. 1758	-	-	1 -	1 -	3	19 6	11	26	22 9	3 2	1 1	1	7	64	v	6	5	1	Geb (WL)	A6-E7	
67	Miltochrista miniata Forster 1771	-	-	- -	- -	-	- -	-	-	- -	- -	- -	-	4	5	-	2	-	-	Hy (Geb)	E6-A8	
68	Lithosia quadra L. 1758	-	-	- 1	- 1	-	6 1	2	-	3 3	- -	- -	-	-	-	-	-	4	-	Geb (W)	A7-A8	
69	Eilema depressa Esp. 1787	-	-	11 7	14 36	12	64 174	162	82	46 107	1 2	1 4	-	1	2	n-h	-	64	1	WN (Geb)	E6-A9	
70	Eilema lutarella L. 1758	-	-	- -	- -	-	- -	-	-	- 1	- -	- -	-	-	-	-	-	-	-	Xe	E7-A8	Im Mallertshofer Holz 1989 9 Ex., auch T
71	Eilema complana L. 1758	-	-	- -	- 1	-	10 5	3	2	9 2	- -	7 2	-	-	12	v-h	2	17	-	Geb	E6-E8	
72	Eilema lurideola Zincken 1817	-	-	- -	- -	-	5 -	-	-	3 1	- -	- -	-	-	-	-	-	5	-	Geb	M7-M8	
73	Systropha sororcula Hufn. 1766	-	-	5 1	5 1	3	19 16	15	18	30 34	- -	- -	1	2	3	v-h	-	60	1	Geb (W)	M5-A7	
74	Atolmis rubricollis L. 1758	-	-	2 -	-* -	1	28 16	23	7	8 -	- -	1 -	-	-	-	2	-	17	-	Geb (W)	A6-M7	* 1986 1 R
75	Phragmatobia fuliginosa L. 1758	1	3	1 1	- 10	11	35 31	14	22	75 33	47 9	50 22	5	4	12	f-n	37	32	23	mGr (Geb)	A5-E5, A7-E8	1. Generation selten
76	Spilarctia lubricipeda L. 1758	-	4	2 3	7 60	-	2 2	1	3	4 4	- 2	2 3	5	5	7	n	20	3	1	Ub	E5-M7	
77	Spilosoma menthastri Esp. 1786	3	3	5 3	11 20	2	61 45	29	62	27 40	3 4	46 38	17	13	23	n-h	4	20	4	Ub	A5-M7	Birket 1983 h
78	Diacrisia sannio L. 1758	-	-	- -	- -	(T)	38 21	14	26	1 6	5 4	16 34	1	-	1	-	1	8	9	mGr (Xe, Geb)	E5-A7, A8-A9	2. Generation 1988 h, auch T
79	Arctia caja L. 1758	(R)	1	2 2	- 13*	1	5 7	2	5	6 12	10 4	21 5	10	3	40	f-n	57	3	8	Hy (mGr, Geb/R)	M7-M9	*m.Ü.
Endrosidae																						
80	Pelosia muscerda Hufn. 1766	-	-	- -	- -	-	- 1	-	-	- -	- -	- -	-	-	-	-	-	-	-	Hy	E6	
Notodontidae																						
81	Harpyia furcula Cl. 1759	1	-	- -	- -	-	- -	-	-	- 1	- -	- -	1	-	-	-	-	1	-	Geb (WL)	A7-M7	
82	Cerura vinula L. 1758	-	-	1 -	- -	-	1 1	-	-	2 -	5 5	- -	-	-	-	1	-	5	8	Geb/R	E4-M7	R im Schw.-holz h

Nr.	Art	SIEDLUNG			WALD					HALBTROKKENRASEN			"DACHMOOS"			VOR 1987				ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
				Garten		Wasserwerk																
		SiS	SiM	SiN	WaS	WaM	WaN	WNw	WNo	HO	HM	HW	Au	We	Mb	Gar	Mo	HO	HM			
83	Stauropus fagi L. 1758	–	–	–	–	–	–			–	–	–			5	1•	–	2	–	WL (Geb)	A6-M7	•S-Bahnhof 1 zus. Ex. 1986
				–	2		4	2	1	3	–	–	3	1								
84	Hybocampa milhauseri F. 1776	–	–	–	–	–	–			1	–	–			–	2	–	–	–	WL (Geb)	M6-A6	1989 im Franzosenhölzl • an WaS je 1 frisches ♀
				–	–		–	–	–	–	–	–	–	–								
85	Gluphisia crenata Esp. 1786	–	1	–	–	–	–			–	–	–			2	–	–	–	–	Hy (WL, Geb)	M6-A7	1989 im Franzosenhölzl • an We je ein Ex.
				–	–		–	–	–	–	–	1	–	1								
86	Drymonia trimacula Esp. 1785	–	–	1	4	–	–			8	–	1			–	v	–	10	1	WL (Geb)	M5-E6	
				–	3		–	1	1	5	–	–	–	–								
87	Drymonia ruficornis Hufn. 1766	–	–	2	11	7	1			15	–	–			–	h	–•	104	–	WL (Geb)	E4-A6	• F.F.w.r., im Kapuzinerholz 1989 h
				–	1		1	2	–	17	–	–	–	1								
88	Peridea anceps Goeze 1781	–	–	3	6	6	3			21	–	3			1•	n-h	–	65	–	WL (Geb)	E4-M6	•am Rand des Birkets
				3	3		2	–	3	60	1	1	2	–								
89	Pheosia tremula Cl. 1759	–	–	–	–	–	1			1	1	7			12	1	2	2	–	Hy (WL, Geb/R)	E5-E6, M7-M8	
				–	–		–	1	–	–	5	4	10	12								
90	Pheosia gnoma F. 1777	1	2	2	–	–	1			1	2	2			43	n-h	25	6	4	Hy (WL, Geb)	A5-A7, M7-M8	
				–	14		1	–	1	2	–	1	2	2								
91	Notodonta phoebe Siebert 1790	–	–	–	–	–	–			–	–	–			–	1	–	–	–	WL (Geb)	E7	
				–	–		–	–	–	–	–	–	–	–								
92	Notodonta dromedarius L. 1767	–	1	2	1	–	2			–	2	1			1	v-h	–	8	2	Geb (WL)	A5-A7, M7-M8	SiN 1987 R
				1	2		3	1	6	–	–	1	3	–								
93	Notodonta ziczac L. 1758	–	2	–	2	1	2			1	10	5			7	3	4	6	12	Geb/R (Ub)	A5-E6, A7-M8	
				1	1		1	1	1	1	4	6	–	1								
94	Leucodonta bicoloria Schiff. 1775	–	–	–	2	1	2			1	–	–			4	1	–	2	–	WL (Geb, Hy)	M5-A7	1989 an SiN M5 1 ♀
				–	2		–	1	–	5	–	–	–	1								
95	Odontosia carmelita Esp. 1799	–	–	–	1	–	–			–	–	–			–	–	–•	2	–	WL	E4-A5	•F.F.w.r
				–	–		–	–	–	–	–	–	–	–								
96	Lophopteryx camelina L. 1758	–	–	2	4	2	1			5	–	4			9	f-n	–	11	–	WL (Geb)	A5-M8 (2 Generationen)	
				2	13		5	1	7	12	1	4	17	6								
97	Lophopteryx cucullia Esp. 1786	–	–	1	–	–	1			9	–	–			1	1	–	9	1	WL (Geb)	M6-A8•	Regattastr 1983 1 R •1989 1 Ex E5 (WaN)
				–	3		–	1	1	–	–	1	1	–								
98	Ptilophora plumigera Schiff. 1775	–	–	–	–	–	–			–	–	–			–	–	–•	–	–	WL (Geb)	E10-M11	
				–	2		–	–	1	4	–	–	7	–								
99	Pterostoma palpina Cl. 1759	1	–	2	–	–	–			–	2	4			1•	f-v	6	1	4	Geb/R (Ub)	E4-M8 (2 Generationen)	• am Rand des Birkets
				–	2		2	–	1	2	–	1	1	2								
100	Phalera bucephala L. 1758	–	–	–	10	3	1			11	1	2			28	n-h	7	20	2	Geb (WL)	E5-E7	
				–	6		4	1	1	6	1	2	7	17								
101	Clostera curtula L. 1758	1	2	–	–	–	2			1	3	5			3	–	7	2	4	Geb/R (Hy)	E4-E5, M7–A8	
				–	–		–	1	2	–	–	3	–	5								
102	Clostera anachoreta F. 1787	–	–	–	–	–	–			–	–	1			2	–	1	–	–	Hy (Geb/R)	A5, E7-A8	1989 3 zus Ex. am Franzosenhölzl
				–	–		–	–	–	–	–	–	–	–								
103	Clostera pigra Hufn. 1766	–	–	–	–	1	1			1	3	4			3	–	2	–	6	Geb/R (Hy)	E4-M5, A7-E8	HM 1986 1 R •S-Bahnhof 1988 1 Ex
				–•	–		1	1	–	–	–	2	–	3								
Zygaenidae																						
104	Lictoria achilleae Esp. 1780	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	mGr (Xe, Geb)	M6-M7	T, 1989 im Mallertshofer Holz h
		–	–	–	–	–	–	–	–	–	–	–	–	–	–							
105	Thermophila meliloti Esp. 1793	–	–	–	–	–	–	–	–	•	–	–	–	–	–	–	–	•	–	W (Geb, mGr)	A7-E7	T
		–	–	–	–	–	–	–	–	•	–	–	–	–	–							
106	Zygaena filipendulae L. 1758	–	–	–	–	•	•	•	•	•	•	•	–	•	–	–	–	•	•	Geb (mGr, W)	E6-M8	T
		–	–	–	–	•	•	•	•	•	•	•	–	•	–							
107	Huebneriana lonicerae Schev. 1777	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	mGr (Xe, Geb)	M7•	T, •1989 im Mallertshofer Holz 1 Ex.
		–	–	–	–	–	–	–	–	–	–	–	–	–	–							
108	Burgeffia ephialtes L. 1767	–	–	–	–	–	–	–	–	•	•	–	–	–	–	(3)•	–	•	•	Xe (mGr)	E7-M8	T •200 m vom Garten entfernt
		–	–	–	–	–	–	–	–	•	•	–	–	–	–							
Cochlididae																						
109	Apoda limacodes Hufn. 1766	2	1	6	10	11	27			44	2	21			24	f-h	2	19	3	Ub (WL, Geb)	M6-E7	
				2	10		2	2	2	17	2	8	1	2								
110	Heterogenea asella Schiff. 1775	–	–	–	–	–	(P)	(P)	(P)	–	–	–			–	–	–	–	–	WL	E6	am L. n. opt 1987 3, 1988 40 Kokons
				–	–		(P)	1	(P)	–	–	–	–	–								

Nr.	Art	SIEDLUNG SiS	SiM	Garten SiN	WALD WaS	WaM	Wasserwerk WaN	WNw	WNo	HALBTROKKENRASEN HO	HM	HW	"DACHMOOS" Au	We	Mb	VOR 1987 Gar	Mo	HO	HM	ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
	Sphingidae																					
111	Mimas tiliae L. 1758	–	–	3	2	–	–			3	–	2			1	v–n	–	1	1	WL (Geb)	A5–E6	T: SiN 1987 1 Ex.
				2	10		2	2	2	2	–	4	–	–								
112	Laothoe populi L. 1758	1	3	–	1	1	1			–	1	3			4	–	18	–	3	Hy (Geb/R)	A5–A8 (vermutl. 2 Gener.)	"Mo" 1983 3 Ex.
				–	–		1	–	1	1	1	–	2	3								
113	Smerinthus ocellata L. 1758	1	–	–	–	–	1			2	3	1			3	3	9	1	8	Geb/R	M5–M7	"Mo" 1983 2 Ex. •m. U.
				–	6•		–	–	1	–	4	2	–	1								
114	Herse convolvuli L. 1758	–	–	–	1	–	–			–	–	2			–	–	–	–	–	Ub/Wf (Agr)	A7–A9	
				–	–		–	–	–	–	–	1	–	–								
115	Sphinx ligustri L. 1758	–	–	–	–	–	–			–	–	1			–	2	2	–	–	Geb	E5–M7	SiN 1977 R
				–	1		–	–	–	1	1	–	–	–								
116	Hyloicus pinastri L. 1758	–	–	3	6	–	13			1	–	–			–	v–n	1	6	4	WN• (Geb)	A5–M8	SiN 1988 R •Wf (RR)
				3	20		14	19	8	3	–	–	–	–								
117	Deilephila elpenor L. 1758	1	–	1	–	–	–			–	–	1			–	f–v	–	–	–	Ub (Geb/R, W)	M6–M7	WaN 1982 1 Ex. ruhend (T)
				1	–		2	–	2	–	1	1	–	–								
118	Deilephila porcellus L. 1758	–	–	–	–	–	–			–	1	24			–	3	–	–	2	Xe (mGr)	M5–M7, M8 (1 Ex.)	
				1	–		–	1	–	–	–	8	–	–								
119	Macroglossum stellatarum L. 1758	+	+	+	–	–	+	+	+	+	+	+	–	–	–	v–h	–	+	+	Ub/Wf (Xe)	A6–M7, A9–A10	T, 1983 ein Ex. am Licht
		–	+	+	–	–	+	+	+	+	+	+	–	–	–							
120	Hemaris fuciformis L. 1758	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1•	–	–	–	Geb (W)		T, •1974
		–	–	–	–	–	–	–	–	–	–	–	–	–	–							
	Thyatiridae																					
121	Habrosyne pyritoides HUFN. 1766	2	–	2	1	1	16			3	1	3			3	v–n	12	11	3	Ub (Geb)	E5–A8	
				2	29		19	7	15	11	6	3	1	1								
122	Thyatira batis L. 1758	–	–	2	2	–	11			1	–	1			2	f–v	–	–	–	Geb	E5–M7, M7–E8	HO 1988 R
				1	6		4	–	7	(R)	–	–	2	3								
123	Tethea fluctuosa HBN. [1803] 1796	–	–	–	–	–	–			–	–	–			–	1	–	1	–	WL (Geb•)	A7–E7	• auch Moore und Heiden
				–	3		2	1	–	–	–	–	–	–								
124	Tethea duplaris L. 1761	–	–	–	2	–	2			–	–	1			43	n	10	1	–	Hy (WL, Geb)	M6–M8	
				–	6		7	4	5	2	–	1	–	23								
125	Tethea or SCHIFF. 1775	–	–	–	–	–	–			1	–	–			2	–	–	–	–	Geb (WL)	A6–M8	
				–	–		–	–	–	–	–	1	–	3								
126	Tethea ocularis L. 1767	–	–	–	–	–	–			–	–	–			–	1	–	–	–	WL (Geb)	E5	
				–	–		–	–	–	–	–	–	–	–								
127	Polyploca flavicornis L. 1758	–	–	7	1	–	2			4	–	1			–	n	–•	–•	–•	Geb•• (WL)	E3–E4	•F.F.w.r., •• auch Moore und Heiden
				–	1		7	1	1	6	–	–	–	2								
	Drepanidae																					
128	Drepana falcataria L. 1758	–	–	1	2	1	8			8	1	2			10	n	11	16	–	WL (Geb)	E4–E8 (2 Generationen)	
				2	6		14	5	3	2	1	6	1	4								
129	Drepana lacertinaria L. 1758	–	–	–	–	–	–			–	–	–			3	1	2	3	–	WL (Hy, Geb)	A5–M8 (2 Generationen)	
				–	1		–	–	–	–	–	–	–	2								
130	Drepana binaria HUFN. 1767	1	–	3	1	–	1			39	–	2			2	n–h	9	125	1	WL (Geb)	A5–M6, M7–E8, M9	3. Generation nur partiell
				10	7		8	5	2	23	2	2	1	2								
131	Drepana cultraria F. 1775	–	–	–	–	3	4			1	1	–			–	f–n	–	3	2	WL (Geb)	A5–E5, A7–E8	
				–	2		20	44	15	–	–	–	–	2								
132	Cilix glaucata SCOP. 1763	–	–	–	–	–	–			1	–	1			–	1	–	–	–	Xe (Geb)	E7	
				–	–		–	–	1	–	–	–	–	–								
	Saturniidae																					
133	Eudia pavonia L. 1758	–	–	–	–	–	–			–	–	–			–	–	–•	–	–	Geb••	E4–A5	am L.: ♀♀, ♂♂ nur T, 1989 ♂♂ im Mallertshofer Holz, •F.F.w.r. •• auch Moore und Heiden
				–	–		1	–	1	–	1	–	–	–								

Nr.	Art	SIEDLUNG		Garten		WALD		Wasserwerk		HALBTROK-KENRASEN			"DACH. MOOS"			VOR 1987				ÖKO-LO-GIE	FLUG-ZEIT	BEMER-KUNGEN
		SiS	SiM	SiN	WaS	WaM	WaN	WNw	WNo	HO	HM	HW	Au	We	Mb	Gar	Mo	HO	HM			
	Lasiocampidae																					
134	Malacosoma neustria L. 1758	-	1	- 1	- -	1	2 3	2	1	- -	- -	1 2	-	-	-	2	4	7	-	Agr (Geb)	E6-E7	Im Moos als R mehrfach
135	Poecilocampa populi L. 1758	-	-	1 2	1 2	-	6 3	3	1	17 56	1 -	1 2	13	3	4	n-sh	-•	16	-•	WL (Geb)	M10-M11	•F.F.w.r.
136	Pachygastria trifolii SCHIFF. 1775	-	-	- 1	- -	-	- 3	-	-	4 8	11 12	46 32	-	-	-	-	-	6	12	mGr (Xe)	A8-M9	♂♂ + ♀♀ am L.(I) HO + HM viele R (1988)
137	Macrothylatia rubi L. 1758	1	-	- -	- -	-	- 1	1	-	- -	- 2	1 5	-	-	-	1	-	-	1	mGr (Geb/R)	M5-M7	am L. v.a. ♀♀, auch T, im Berglwald als R regelmäßig
138	Philudoria potatoria L. 1758	-	-	- -	- 1	-	1 3	1	2	- -	- -	- -	-	-	-	-	-	-	-	Hy (mGr)	A7-E8	1989 wieder 1 ♂ im Garten
139	Cosmotriche lunigera ESP. 1784	-	-	- -	- -	-	- -	-	-	- -	- -	- -	-	-	-	-	-	-	-	WN (Geb)	A6	1989 1 Ex. im Mallertshofer Holz
140	Dendrolimus pini L. 1758	-	-	- -	- -	-	- -	2	-	- 1	- -	- -	-	-	-	-	-	-	-	WN	A6-M7	
	Psychidae																					
141	Sterrhopteryx fusca HAW. 1809	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1• -	-	1•	-	-	Hy (W)	E6	T, ♂♂, •am Licht
142	Psyche crassiorella BRUAND 1849	- -	- -	- -	- -	(R) (R)	- -	- -	- -	- -	- -	- -	- -	- -	- -	-	-	-	-	Geb (W)		T, ♂♂
143	Psyche casta PALLAS 1767	(R) -	- -	(R) (R)	(R) (R)	(R) (R)	(R) (R)	(R) (R)	(R) (R)	- (R)•	- (R)••	- -	- (R)	(R) (R)	(R) (R)	v(R)	-	-	-	Ub (Geb)		T, ♂♂, • auch im Schw.holz, •• im Ruderal
144	Proutia betulina Z. 1839	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- (R)	- -	-	-	-	-	Geb (Hy)		T, ♂♂
145	Bacotia sepium SPR. 1846	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-	-	-	-	W (Geb)		T, ♂♂
146	Talaeporia tubulosa RETZ. 1783	- -	- -	- -	- -	(R) (R)	(R) (R)	(R) (R)	(R) (R)	- -	- -	- -	- -	- -	- -	-	-	-	-	W (Geb)		T, ♂♂, im Mallertshofer Holz 1989 1 Sack
147	Dahlica triquetrella HBN. 1812	- -	- -	(R) (R)	(R) (R)	(R) (R)	(R) (R)	(R) (R)	(R) (R)	(R) (R)	- -	- -	- -	- -	- -	h(R)	-	(R)	-	W (Ub)		nur ♀♀ (Parthenogenese)
148	Narycia monilifera GEOFFR. 1785	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-	-	-	-	W (Geb)		♂♂ + ♀♀ geflügelt, 1989 1 Sack im Mallertshofer Holz
	Aegeriidae																					
149	Chamaesphecia empiformis ESP. 1783	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-	-	-	-	mGr (Geb)	A7	T, Berglwald 1982 1 Ex
	Cossidae																					
150	Cossus cossus L. 1758	-	1	- -	- -	-	- -	-	-	- -	- -	- -	-	-	-	-	-	-	-	Geb (Hy)	M7	
151	Zeuzera pyrina L. 1761	-	-	- -	- -	1	- -	-	-	- -	- -	1 -	-	-	1	2	-	-	-	Geb (WL)	A7-M8	
	Hepialidae																					
152	Hepialus humuli L. 1758	-	-	1 2	- 2	1	1 3	-	4	4 1	- -	- -	1	-	-•	f-n	4	3	-	Hy (mGr, Geb)	A6-A8	•Entw.graben 1 Ex., dort 1983 2 Ex., am L. n opt.
153	Hepialus sylvina L. 1761	5	1	8 20	9 33	2	5 11	3	9	10 23	- 2	17 39	2	1	-	h	-	7	10	mGr (Geb, Ub)	A8-M9	
154	Hepialus hecta L. 1758	-	-	- -	- 1	-	- -	-	-	- -	- -	- -	+•	1••	-	-	-	-	-	Geb (Hy)	A6-A7	•Däm. 10 Ex., ••Däm. ein zus Ex., Berglwald 1982/86 T 2 Ex

Nr.	Art	SIEDLUNG SiS	SiM	Garten SiN	WALD WaS	WaM	Wasserwerk WaN	WNw	WNo	HALBTROKKENRASEN HO	HM	HW	"DACH. MOOS" Au	We	Mb	VOR 1987 Gar	Mo	HO	HM	ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
	Noctuidae																					
	Noctuinae																					
155	Euxoa obelisca	-	-	-	-	-	-			-	-	-			-	1	-	-	-	Xe (mGr)	M8-E8	
	SCHIFF. 1775			-	1		-	-	-	-	1	1	-	-								
156	Euxoa tritici	-	-	1	-	-	-			-	-	2			-	-	-	-	-	mGr (Agr, Xe)	M7-M9	
	L. 1761			-	-		-	1	-	-	-	1	-	-								
157	Euxoa nigricans	-	1	-	-	-	-			-	-	-			-	1	-	-	-	mGr (Agr)	A8-M9	
	L. 1761			-	-		-	-	-	-	-	1	-	-								
158	Euxoa aquilina	-	-	-	-	-	2			-	2	2			-	f-n	-	2	-	mGr (Xe, Agr)	M7-M8	Im Garten nur 1983
	SCHIFF. 1775			-	-		16	-	6	-	-	2	-	-								
159	Scotia segetum	-	3	2	1	-	2			3	1	4			-	f-n	-	1	-	Agr• (Ub)	A6-E7, E8-M10	•Wf (RR)
	SCHIFF. 1775			-	-		-	-	-	-	1	1	-	-								
160	Scotia clavis	3	28	32	48	5	12			57	21	84			1	h-sh	-	106	21	mGr (Xe, Geb)	A6-E7	
	HUFN. 1766			27	175		14	20	7	33	32	48	-	1								
161	Scotia exclamationis	2	38	36	29	9	52			56	32	80			-	h-sh	9	56	16	mGr• (Ub, Agr)	M5-E7, E7-E8	2. Generation nur sehr partiell •Wf (RR)
	L. 1758			32	84		39	4	29	62	45	69	-	4								
162	Scotia ipsilon	4	94	8	29	3	5			12	6	25			1	h	91	4	2	Ub/Wf (Agr)	A6-A11	
	HUFN. 1766			3	45		7	4	5	2	7	10	2	-								
163	Ochropleura plecta	2	41	23	21	3	54			40	39	119			24	h-sh	16	20	14	Ub (mGr, Geb)	A5-M7, M7-E9	
	L. 1761			104	482		263	68	124	213	49	165	18	28								
164	Eugnorisma depuncta	-	-	-	-	-	-			-	-	-			-	-	1	-	-	mGr• (Geb)	A8	•auch Heiden und Moore
	L. 1761			-	-		-	-	-	-	-	-	-	-								
165	Rhyacia lucipeta	-	-	-	-	-	-			-	-	-			-	-	-	-	-	Xe• (mGr)	M8	•Wf (RR)
	SCHIFF. 1775			-	-		1	-	-	-	-	-	-	-								
166	Rhyacia simulans	-	-	-	-	-	-			-	-	-			-	-	-	-	-	Xe• (mGr)	E9	•Wf (RR)
	HUFN. 1766			-	-		-	-	-	-	-	1	-	-								
167	Noctua pronuba	9	38	18	80	4	26			45	26	54			-	h	27	39	8	Ub/Wf (Geb)	A6-A11	
	L. 1758			48	1011		75	94	42	123	13	95	35	4								
168	Noctua comes	-	7	5	6	-	2			3	2	8			-	v-h	2	-	-	Agr• (Ub, Geb)	A8-E9••	•Wf (RR) ••1 Ex. bereits A7
	HBN. [1813]			5	69		-	2	2	-	-	1	-	-								
169	Noctua fimbriata	-	1	2	2	-	4			3	-	4			1	f-v	9	4	1	mGr• (Agr, Geb)	M7-M9	•Wf (RR)
	SCHREBER 1759			1	5		7	3	5	-	1	4	-	-								
170	Noctua janthina	1	1	-	-	2	-			2	2	-			1	v-h	12	2	1	Ub• (mGr)	M7-E9	•Wf (RR)
	SCHIFF. 1775			2	16		1	-	2	3	-	1	1	-								
171	Spaelotis ravida	-	-	-	-	-	-			-	-	-			-	1	4	-	-	Agr• (mGr)	A7-M7, M9-E9	•Wf (RR)
	SCHIFF. 1775			-	-		1	-	1	-	-	1	-	-								
172	Graphiphora augur	-	-	-	-	-	-			-	-	-			-	f-v	2	-	1	Ub (Geb)	M6-M7	
	F. 1775			1	2		-	-	-	-	-	-	-	-								
173	Paradiarsia punicea	-	-	-	-	-	1			-	-	1			7	-	-	-	-	Hy (WL)	E6-M7	WaN 1989 1 Ex.
	HBN. [1803]			-	-		-	-	-	1	-	-	-	-								
174	Diarsia mendica	-	-	2	9	3	2			8	-	-			-	3	-	2	-	W (Geb)	E5-M7	
	F. 1775			1	23		4	10	4	9	-	-	1	-								
175	Diarsia brunnea	-	1	7	18	4	5			6	-	-			1	v-h	-	5	-	W (Geb)	M6-M8	
	SCHIFF. 1775			6	120		11	9	8	3	-	-	3	2								
176	Diarsia rubi	-	-	-	1	-	-			-	-	-			2	1	3	1	-	Hy (Agr, Geb)	M5-M6, A7-A9	
	VIEWEG 1790			-	3		4	-	1	3	-	6	1	1								
177	Amathes c-nigrum	-	82	9	15	5	30			28	21	95			4	n-sh	22•	13	15	Ub•• (Agr, mGr)	M5-A7, E7-M10	• "Mo" am 5.6.83 11 Ex., ••Wf (RR)
	L. 1758			48	336		180	32	208	138	72	176	27	9								
178	Amathes ditrapezium	8	6	12	23	3	44			25	8	5			24	h	126	52	11	Ub	M6-M8	
	SCHIFF. 1775			19	127		60	31	43	28	4	4	32	25								
179	Amathes triangulum	8	12	10	48	3	62			51	6	15			6	h	78	55	3	Ub (Geb)	A6-A8	
	HUFN. 1766			59	541		85	42	80	45	2	12	17	9								
180	Amathes baja	1	2	2	10	-	22			31	1	5			8	h	-	10	-	Geb (mGr)	M7-M9	
	SCHIFF. 1775			1	43		24	9	53	17	1	7	1	2								
181	Amathes sextrigata	2	1	1	-	16	232			106	15	46			38	1	1	13	5	mGr (Geb)	E7-A9	
	HAW. 1809			1	22		141	62	173	138	53	82	5	-								

Nr	Art	SIEDLUNG		Garten	WALD		Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"			VOR 1987				ÖKOLOGIE	FLUG-ZEIT	BEMER-KUNGEN
		SiS	SiM	SiN	WaS	WaM	WaN	WNw	WNo	HO	HM	HW	Au	We	Mb	Gar	Mo	HO	HM			
182	Amathes xanthographa SCHIFF. 1775	5	4	3 4	7 36	7	41 32	39	77	33 18	18 16	27 26	5	1	2	h	7	13	52	mGr (Geb, Ub)	M8–E9, M10•	•1 frisches Ex am 16.10.88
183	Phalaena typica L. 1758	–	–	– –	– 3	–	– –	–	–	– –	– –	– –	1	1	–	1	1	–	–	Geb (Hy)	M7–A9•	•WaS 1989 schon M6
184	Eurois occulta L. 1758	–	1	– –	– 2	1	– –	–	–	– –	– –	– –	–	–	–	1	–	–	–	mGr (W, Geb)	A7–E8	
185	Anaplectoides prasina SCHIFF. 1775	–	–	– –	– 11	–	3 22	3	4	3 –	– –	– 1	3	1	–	2	–	5	2	Geb (mGr)	A6–E7	
186	Cerastis rubricosa SCHIFF. 1775	–	1	1 –	1 2	2	48 39	26	25	6 10	6 1	2 4	–	–	–	v	–•	4	11	mGr (Geb)	E3–E6••	•F.F.w.r., ••am Ende der Flugzeit frische Stücke
187	Cerastis leucographa SCHIFF. 1775	–	–	– 1	1 –	–	8 5	3	3	1 1	– –	– –	–	–	–	–	–•	2	–	Geb	M4–E5	•F.F.w.r.
188	Mesogona oxalina HBN. [1803]	–	–	– –	– –	–	– –	–	–	– –	4 1	– –	–	10	–	–	2	–	5	Geb/R (Hy)	E8–E9	
Hadeninae																						
189	Discestra trifolii HUFN. 1766	–	3	– –	– 2	–	3 3	–	1	1 –	– –	11 4	–	–	–	3	–	2	2	Ub/Wf (Agr)	E5–A7, M7–A9	2. Generation zahlreicher
190	Polia bombycina HUFN. 1766	–	1	– –	– 2	1	14 7	2	10	3 4	1 4	11 11	–	–	–	v	3	3	10	mGr (Geb)	M6–A8	
191	Polia nebulosa HUFN. 1766	–	–	2 –	5 12	–	3 3	2	7	1 –	– –	– –	2	–	1	3	–	3	–	Geb	A6–E7	
192	Pachetra sagittigera HUFN. 1766	–	–	– –	– –	–	– –	–	–	5 3	35 14	44 15	–	–	–	–	–	3	24	mGr (Xe)	M5–E6	WaN 1989 2 Ex.
193	Sideridis albicolon HBN. [1813] 1809	–	–	– –	– –	–	– –	–	–	– –	1 –	4 1	–	–	–	–	–	–	1	Xe (mGr)	M5–A7	
194	Heliophobus reticulata GOEZE 1781	–	–	– –	– –	–	– –	–	–	– 1	4 4	4 3	–	–	–	–	–	–	2	Xe (mGr)	A6–M7	
195	Mamestra brassicae L. 1758	–	4	– –	2 30	–	1 1	1	5	– 4	1 4	4 5	–	–	1	v	–	1	2	Agr• (mGr)	E5–E9 (2 Generationen)	•Wf (RR)
196	Mamestra persicariae L. 1761	1	10	9 10	8 47	3	13 22	3	11	2 1	1 1	– 1	2	1	–	n–h	5	2	1	Ub (Geb, Agr)	A6–A8	
197	Mamestra contigua SCHIFF. 1775	–	1	1 –	– 3	–	4 3	–	1	– –	– 3	3 –	–	–	1	3	–	–	2	Geb (mGr)	E5–M7, A8–A9•	•2. Generation nur partiell
198	Mamestra w-latinum HUFN. 1766	–	–	– –	1 3	–	5 –	–	–	1 –	7 2	15 10	–	–	–	f–v	–	1	10	mGr (Xe)	M5–A7	
199	Mamestra thalassina HUFN. 1766	–	2	4 2	7 35	–	2 3	2	3	2 2	1 –	3 4	3	–	2	n–h	–	2	–	Geb	M5–M7	1987 2 Ex. E7
200	Mamestra suasa SCHIFF. 1775	–	14	4 6	2 58	1	12 49	10	58	8 8	19 20	30 67	7	–	1	v–h	4	3	9	Ub (mGr, Agr)	E4–E6, M7–M9	2 vorzeitig geschlüpfte Ex. A7
201	Mamestra oleracea L. 1758	–	7	3 6	5 55	1	1 7	–	1	– 1	– –	– 1	–	–	–	n–h	1	2	1	Agr (Geb)	E5–A8, M8–A9•	•nur vereinzelte Ex.
202	Mamestra pisi L. 1758	–	–	– –	– –	–	– –	–	1	– –	– 2	1 –	–	–	–	v•	–	–	–	mGr (Agr, Geb)	A6–M7	•nur vor 1982
203	Hadena rivularis F. 1775	–	1	– –	– 2	–	– 2	–	1	– –	– –	3 1	–	–	–	f–v	–	–	1•	mGr (Agr)	E5–E6, E7–A9	•HM 1986 zusätzlich 1 R
204	Hadena lepida ESP. 1790	–	–	– –	– –	–	– –	–	–	– –	– 1	6 3	–	–	–	1	–	–	–	mGr (Xe)	M6–M7	1989 wieder 1 Ex. im Garten
205	Hadena compta SCHIFF. 1775	–	–	– 1	1 1	–	– –	–	–	– –	– –	1 1	–	–	–	f–v	–	–	–	mGr (Xe)	M6–M7	
206	Hadena confusa HUFN. 1766	–	–	– –	– –	–	– –	–	–	– –	– –	– –	–	–	–	1	1	–	–	mGr	E6	
207	Hadena bicruris HUFN. 1766	–	–	1 –	– 1	–	– –	–	–	1 –	– –	2 –	–	–	–	1	–	1	–	mGr (Geb)	M5–A8, A9•	•1 Ex. 1987

Nr.	Art	SIEDLUNG SiS	SiM	Garten SiN	WALD WaS	WaM	Wasserwerk WaN	WNw	WNo	HALBTROKKENRASEN HO	HM	HW	"DACHMOOS" Au	We	Mb	VOR 1987 Gar	Mo	HO	HM	ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
208	Lasionycta nana HUFN. 1766	–	–	– / –	– / –	–	– / –	–	–	– / –	– / –	1 / –	–	–	–	1	–	–	–	Geb (mGr)	M6*	*im Garten im "Juli" 1983
209	Eriopygodes imbecilla F. 1794	–	–	– / –	– / –	–	– / –	–	–	– / –	– / –	– / –	–	–	1	–	–	–	–	Hy	E6	1989 ein Ex. im Franzosenhölzl
210	Cerapteryx graminis L. 1758	–	–	– / –	– / –	–	– / –	–	–	1 / –	– / –	– / –	–	–	–	–	–	–	–	mGr (Geb, Hy)	M8	
211	Tholera cespitis SCHIFF. 1776	–	–	– / –	– / –	–	– / –	–	–	1 / –	– / –	– / –	–	–	–	–	–	1	2	mGr	A9–M9	
212	Tholera decimalis PODA 1761	–	–	3 / 1	3 / 2	2	7 / 1	1	3	54 / 27	68 / 42	40 / 31	–	–	1	n–h	1	27	130	mGr	E8–M9	
213	Panolis flammea SCHIFF. 1776	–	–	11 / 13	7 / 1	4	17 / 7	5	10	1 / 5	3 / –	– / –	1	–	–	h	–*	19	12	WN (Geb)	M3–A6	*F.F.w.r.
214	Orthosia cruda SCHIFF. 1775	–	8	14 / 10	9 / 1	–	6 / 5	6	3	29 / 57	9 / –	9 / 2	2	6	–	n–h	–*	5	2	WL (Geb)	M3–M5	*F.F.w.r.
215	Orthosia populi STRÖM 1783	–	1	– / 2	– / 1	–	– / –	–	1	– / –	1 / –	– / –	–	31	–	2	–*	–*	–*	Geb (Hy)	M3–M4	*F.F.w.r.
216	Orthosia gracilis SCHIFF. 1776	1	2	3 / 1	1 / –	2	6 / 2	3	4	– / 2	1 / –	– / 1	–	1	– (T:1)	f–v	–*	1	1	Ub (Hy)	A4–M5	*F.F.w.r.
217	Orthosia stabilis SCHIFF. 1776	3	7	32 / 16	13 / 13	1	16 / 22	6	8	10 / 28	6 / 1	– / 5	1	4	3	h–sh	–*	23	2	Ub (WL, Geb)	M3–M5	1987 noch am 22.5. 1 Ex. *F.F.w.r.
218	Orthosia incerta HUFN. 1766	4	29	60 / 5	15 / 5	6	24 / 30	10	22	15 / 16	8 / 1	10 / 5	1	15	4	h–sh	–*	13	6	Ub (WL, Geb)	A3–M5	1982 noch am 22.5. 1 Ex. *F.F.w.r.
219	Orthosia munda SCHIFF. 1775	–	1	9 / 1	3 / 2	–	1 / 1	–	1	1 / 5	1 / –	– / –	–	–	(R)	v–h	–*	–	–	WL (Geb)	M3–E4	Birket 1983 1 R, HO 1987 2 R *F.F.w.r.
220	Orthosia gothica L. 1775	30	25	117 / 39	57 / 38	13	135 / 89	60	71	37 / 37	11 / 7	19 / 15	8	21	13	sh	–*	29	20	Ub (Geb)	A3–E5	*F.F.w.r.
221	Mythimna turca L. 1761	–	–	1 / 1	7 / 26	2	12 / 30	18	16	7 / 5	– / –	– / –	–	1	7	f–n	8	1	1	Hy (Geb, mGr)	M6–E7	
222	Mythimna conigera SCHIFF. 1775	–	–	– / –	1 / –	–	32 / 15	2	9	1 / 1	1 / 1	6 / 2	–	–	–	2	–	4	–	mGr (Geb, Xe)	E6–E7	
223	Mythimna ferrago F. 1787	–	2	2 / 2	– / 7	1	14 / 7	5	11	3 / –	3 / –	4 / 2	–	–	–	n–h	1	1	3	mGr* (Geb)	E6–M8	*Wf (RR)
224	Mythimna albipuncta SCHIFF. 1776	–	6	– / –	1 / 1	1	1 / –	–	2	1 / 1	– / 1	2 / 4	1	1	–	v	–	1	–	Agr/Wf (mGr)	A6–M9 (2 Generationen)	
225	Mythimna vitellina HBN. [1808]	–	–	– / –	– / –	1	– / –	–	–	– / –	– / –	– / –	–	–	–	–	–	–	–	Xe/Wf (mGr)	E7	
226	Mythimna pudorina SCHIFF. 1775	–	–	1 / –	– / –	–	– / –	–	1	– / 1	1 / 1	– / –	–	–	–	1	–	–	–	Hy	E6–E7	
227	Mythimna impura HBN. [1808]	5	2	6 / 4	8 / 32	12	83 / 81	37	99	28 / 19	9 / 9	8 / 11	3	5	2	n*	1*	15	9	Hy (Ub, mGr)	M6–A8**, A8–E9 2. Gen. nur part.	*früher z.T. fehlbestimmt **A6 einzeln Entwgr. `87 1Ex
228	Mythimna pallens L. 1758	2	4	2 / 3	1 / 7	1	12 / 12	11	23	3 / 10	6 / 8	9 / 29	4	–	2	v–n*	20*	7	17	mGr (Ub)	A6–M7**, A8–A10	*früher z.T fehlbestimmt **E7 einzeln
229	Mythimna l-album L. 1767	–	–	– / –	– / –	–	– / –	–	–	– / –	– / –	– / –	–	–	–	1*	–	–	–	mGr/Wf (Hy)	M6	*1977
230	Leucania comma L. 1761	–	–	– / –	– / –	–	– / –	–	1	1 / 1	23 / 43	15 / 17	–	–	–	1	–	4	47	mGr	M5–M7	1989 WaN 1 ♂
	Amphipyrinae																					
231	Amphipyra pyramidea L. 1758	2	5	5 / 3	15 / 18	3	5 / 8	2	3	5 / 3	– / –	19 / 7	6	–	1	h	3	14	–	WL* (Geb)	A7–M10	im Juli nur einzeln *Wf (RR)
232	Amphipyra berbera RUNGS 1949	–	–	– / –	– / –	–	– / –	–	–	– / –	– / –	– / –	–	–	–	1	–	–	–	WL* (Geb)	A9	*Wf (RR), Korbinianiholz 1988 2 Ex. Gen.prp.: KOLBECK
233	Amphipyra tragopoginis CL. 1759	4	10	4 / 1	10 / 19	2	9 / 10	3	3	5 / 8	8 / 4	71 / 23	1	–	–	h	9	5	14	Ub (Agr)	E7–M10	1 Ex. am 11.7. (1988)

Nr	Art	SIEDLUNG			WALD					HALBTROKKENRASEN			"DACHMOOS"			VOR 1987				ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
				Garten		Wasserwerk																
		SiS	SiM	SiN	WaS	WaM	WaN	WNw	WNo	HO	HM	HW	Au	We	Mb	Gar	Mo	HO	HM			
234	Rusina ferruginea ESP. 1785	13	1	10 11	27 83	17	90 31	68	43	56 39	1 6	14 7	2	14	53	h	9	36	5	Ub (Geb, mGr)	E5-E7	
235	Talpophila matura HUFN. 1766	-	-	- -	- -	-	- -	-	-	- -	9 4	2 6	-	-	-	-	-	-	6	mGr	M7-M8	
236	Euplexia lucipara L. 1761	-	-	1 2	2 12	-	2 2	6	9	2 2	- -	- -	1	-	-	n-h	1	5	1	Geb	E5-E7	
237	Phlogophora meticulosa L. 1758	-	1	- 1	- 2	-	- 1	-	-	- -	- 4	2 3	1	-	-	f-v	12	-	1	Agr/Wf (mGr)	E5, M8-A11	1. Generation nur 1 Ex. 1986, 1988 1 Ex. am S-Bahnhof.
238	Ipimorpha retusa L. 1761	-	-	- -	- -	1	3 -	-	2	1 -	1 2	- -	-	8	-	-	3	-	-	Geb/R (Hy)	E7-A9	Regattastr. 1983 2 R
239	Ipimorpha subtusa SCHIFF. 1775	-	-	- -	- -	-	- -	-	-	- -	- -	- -	-	1	-	-	12	-	-	Hy (Geb/R)	E7-M8	
240	Enargia paleacea ESP. 1788	-	-	- -	- -	-	- -	-	-	- -	- -	- -	-	-	-	1	1	-	-	Geb*	E7-A8	*v.a. Moore und Heiden
241	Enargia ipsilon SCHIFF. 1775	-	-	- -	- -	-	1 -	-	-	- -	- -	- -	-	2	-	-	1	-	-	Hy (Geb)	M7-E7	
242	Cosmia affinis L. 1767	-	-	- -	- -	-	- -	-	-	- -	- -	- -	-	-	-	-	-	-	-	Geb (WL)		Korbinianiholz 1988 2 Ex KOLBECK
243	Cosmia trapezina L. 1758	3	-	7 5	35 86	5	5 6	5	11	18 18	- -	2 5	6	11	21*	h	8	21	-	WL (Geb)	A7-M9	*Birket-Rand 1988 3 Ex.
244	Cosmia pyralina SCHIFF. 1775	1	-	2 -	- 1	-	1 3	1	3	1 1	- -	- 4	10	7	2	f-h	2	4	-	Geb (WL)	E6-A8	
245	Auchmis comma SCHIFF. 1775	-	1	- 1	- 2	-	- -	-	-	- -	- -	- -	-	-	-	v	-	3	-	Geb (Xe)	A7-E8	
246	Actinotia polyodon CL. 1759	-	-	- -	- -	-	- 2	-	-	- -	1 -	- 1	-	-	-	-	-	-	-	Xe (mGr, Geb)	E6, A8-M8	auch T
247	Actinotia hyperici SCHIFF. 1775	-	-	- -	- -	-	- -	-	-	- -	- -	1 -	-	-	-	-	-	-	-	Xe	M8	auch T
248	Apamea monoglypha HUFN. 1766	-	3	2 -	3 23	-	4 5	4	4	5 4	4 2	4 5	-	-	-	n-h	9	7	7	mGr* (Agr, Geb)	M6-A9	*Wf (RR)
249	Apamea lithoxylea SCHIFF. 1775	-	1	- -	- -	-	- -	-	-	- -	- -	- -	-	-	-	v	-	-	-	Agr (Xe, mGr)	A6-A8	
250	Apamea sublustris ESP 1788	-	-	- 3	- 8	-	2 1	2	1	1 1	11 5	11 7	-	-	-	v	-	9	37	mGr	A6-A7	
251	Apamea crenata HUFN. 1766	-	-	- 2	1 1	-	2 4	2	1	- 2	- -	- -	-	1	1	3	-	3	1	mGr (Geb)	E5-E7	
252	Apamea characterea HBN. [1803]	1	-	- -	- 4	-	- 2	2	1	1 -	1 -	- -	-	-	1	-	-	1	1	Geb (mGr)	A6-E7	
253	Apamea lateritia HUFN. 1766	-	-	- -	- -	-	- -	-	1	- -	- -	- -	-	-	-	-	-	-	-	mGr	A8	
254	Apamea remissa HBN. [1809]	-	1	- 1	- 1	-	4 5	1	4	3 2	3 6	4 3	-	-	-	-	-	1	9	mGr (Hy)	E5-E7	
255	Apamea unanimis HBN. [1813]	-	-	- 1	- 3	-	- -	-	-	1 -	1 -	1 -	-	-	-	1	-	-	-	Hy (mGr)	E5-E6	WaN 1989 ein Ex.
256	Apamea anceps SCHIFF. 1775	-	7	3 -	1 3	-	31 73	9	37	2 2	6 5	29 39	1	-	-	v	1	11	7	Agr (mGr)	E5-E7	
257	Apamea sordens HUFN. 1766	-	-	3 -	1 13	-	- 6	9	8	- 5	3 8	9 19	-	-	-	n	6*	6	2	Agr (mGr, Geb)	E5-M7	* "Mo" 1983 3 Ex.
258	Apamea scolopacina ESP. 1788	-	-	1 4	4 8	-	2 4	1	2	3 2	- -	- -	2	-	2	v-h	3	11	-	Geb (WL, mGr)	M7-E8	
259	Apamea ophiogramma ESP. 1793	-	-	- -	- 1	-	- -	1	-	1 -	- -	1 -	-	1	-	-	2	1	-	Hy	E7-M8	
260	Oligia strigilis L. 1758	-	3	10 6	7 24	-	24 23	13	24	6 18	3 2	19 21	-	1	2	h	2	31	5	Geb (mGr)	E5-E7	

Nr.	Art	SIEDLUNG		Garten		WALD	Wasserwerk			HALBTROKKENRASEN			"DACH. MOOS"			VOR 1987				ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
		SiS	SiM	SiN	WaS	WaM	WaN	WNw	WNo	HO	HM	HW	Au	We	Mb	Gar	Mo	HO	HM			
261	Oligia versicolor BKH. 1792	2	-	4 1	3 3	-	4 18	5	6	- 1	1 -	1 2	-	3	1	v-n	1	4	-	Geb (Hy)	M6-E7	1988 1 Ex. A6
262	Oligia latruncula SCHIFF. 1775	1	14	19 14	22 45	1	115 87	29	60	12 16	7 6	17 26	1	3	2	h	1	10	1	Ub (mGr, Geb)	A6-A8	
263	Miana furuncula SCHIFF. 1775	-	1	1 1	- 3	2	4 14	-	9	2 -	5 1	5 16	-	-	-	f-n	2	1	1	mGr	M7-E8	
264	Mesapamea secalis L. 1758	-	2	- -	3 23	-	7 7	2	9	1 -	3 -	1 4	1	-	-	f-n	4	1	-	mGr (Agr)	M7-E8	alle Stücke Gen.Prp.
265	Mesapamea secalella REMM 1983	-	1	2 5	3 32	1	5 3	1	9	2 1	- 1	2 1	-	-	-	v-n	3	-	-	mGr (Agr)	E6-E8*	alle Stücke Gen.Prp. *E8 nur 2 Ex.
266	Photedes minima HAW. 1809	-	-	- -	- -	-	- -	-	-	- -	- -	- 1	-	7	17	-	-	-	-	Hy (WL)	E6-A8	
267	Photedes extrema HBN. [1809]	-	-	- -	- -	-	- -	-	-	2 3	1 1	2 2	-	-	-	-	-	3	-	Xe (mGr)	E5-A7	1989 WaN 1 ♂, Mallertshofer Holz ♂♀
268	Photedes fluxa HBN. [1809]	1	-	- -	3 3	1	5 7	10	14	7 3	6 -	3 1	1	-	2	f-v	2	3	-	mGr (Geb)	A7-M8	1988 1 Ex. E6
268b	siehe Addenda																					
269	Luperina testacea SCHIFF. 1775	2	5	6 -	5 15	1	2 4	-	5	7 15	7 4	9 9	-	-	-	n-h	7	15	16	mGr (Agr)	A8-M9	
270	Amphipoea oculea L. 1761	-	-	- -	- -	-	- 1	1	-	- -	- -	- -	-	-	-	1	-	-	-	Hy (mGr)	M7-M8	
271	Amphipoea fucosa FRR. 1830	-	5	- 1	1 10	7	29 34	8	22	9 9	13 8	12 12	-	-	-	n-h	6	11	7	mGr (Agr)	A7-M8	
272	Amphipoea lucens FRR. 1845	-	-	- -	- -	-	- -	-	1	- -	- -	- -	-	-	-	-	-	-	-	Hy	A8	Gen.Prp
273	Hydraecia micacea ESP. 1789	2	-	- 1	- 3	1	1 7	3	3	3 3	- -	1 6	-	1	2	2	26	1	1	Hy (Agr)	M7-E9	viele Gen.Prp., noch keine H. ultima
274	Gortyna flavago SCHIFF. 1775	1	-	- -	- -	-	- -	5	-	1 -	- -	1 1	-	-	-	1	3	1	-	Agr (Hy)	M9-A10	
275	Celaena leucostigma HBN. [1808]	-	-	- -	- -	1	- -	-	-	- -	- -	- -	-	-	-	-	-	-	-	Hy*	M8	* Wf (RR)
276	Nonagria typhae THNBG. 1784	-	-	- -	- -	-	- -	-	10	- -	- -	- -	-	-	-	-	-	-	-	Hy	M8-M10	
277	Nonagria nexa HBN. [1808]	-	-	- -	- -	-	- -	-	-	1 -	- -	- -	-	-	-	-	-	-	-	Hy	A9	
278	Rhizedra lutosa HBN. [1803]	-	-	- -	- -	-	- -	-	-	- -	1 1	- 1	-	-	-	-	3	-	2	Hy	E9-M10	
279	Meristis trigrammica HUFN. 1766	-	2	18 27	38 125	1	- 4	5	10	21 37	25 30	5 11	-	1	-	h-sh	-	26	34	mGr (Geb)	M5-A7	1987 1 Ex. M7
280	Hoplodrina alsines BRAHM 1791	9	13	23 24	115 260	15	91 33	11	31	39 15	8 8	25 17	5	1	2	sh	57	48	18	Ub (Geb, mGr)	M6-A8	1987 auch M8 und E8
281	Hoplodrina blanda SCHIFF. 1775	-	-	1 1	- -	-	1 5	1	-	1 2	- -	6 7	1	-	-	-	-	-	-	Geb (mGr)	M6-M8	
282	Hoplodrina ambigua SCHIFF. 1775	-	8	3 3	4 28	-	4 4	-	20	8 10	2 3	9 12	1	-	-	v-h	1	4	2	mGr (Agr)	E5-E6, E7-E9	
283	Atypha pulmonaris ESP. 1790	-	-	- -	- 1	-	- -	-	-	2 1	1 -	- -	-	-	-	-	-	1	-	mGr (Hy)*	M7-E7	*feuchtwarme Standorte
284	Spodoptera exigua HBN. [1808]	-	-	- -	- -	-	- -	-	-	- 1	- -	- 1	-	-	-	-	-	-	-	Xe/Wf	A8-E8	
285	Caradrina morpheus HUFN. 1766	7	22	26 20	41 132	6	54 23	25	40	63 14	6 2	36 8	-	2	3	h-sh	50	13	2	Ub (mGr, Geb)	A6-A8*	*1989 ab M5
286	Paradrina clavipalpis SCOP. 1763	-	-	- -	- -	-	- -	-	-	- -	- -	- -	-	-	-	2	-	-	-	mGr/Wf (Agr)	E7-A8	
287	Eremodrina gilva DONZ. 1837	1	8	2 1	5 4	1	1 -	-	1	- -	1 -	5 9	-	-	-	v-h	-	2	1	Agr* (Ub)	A6-M7	S-Bahnhof 1988 2 Ex.; *z.T. Zuflug aus den Alpen ("Wf")
288	Agrotis venustula HBN. 1790	-	-	- -	2 1	2	8* 7	12	17	2 2	- -	1 2	-	-	-	-	-	5	-	Geb (Xe)	A6-E7	*1 zus. Ex. T

Nr	Art	SIEDLUNG		Garten		WALD		Wasserwerk		HALBTROCKENRASEN			"DACHMOOS"			VOR 1987				ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
		SiS	SiM	SiN	WaS	WaM	WaN	WNw	WNo	HO	HM	HW	Au	We	Mb	Gar	Mo	HO	HM			
	Cuculliinae																					
289	Cucullia lucifuga SCHIFF. 1775	–	–	–	–	–	–			–	–	–			–	–	–	–	–	mGr (Xe)	E5	am L. n. opt.
				–	–		–	–	–	–	–	1	–	–								
290	Cucullia umbratica L. 1758	–	–	–	1	–	1			–	1	3			–	f-v	–	1	–	Agr (mGr)	E5-A8	am L. n. opt
				1	–		–	1	–	–	2	1	–	–								
291	Cucullia verbasci L. 1758	–	–	–	–	(R)	(R)			(R)	(R)•	(R)			–	v(R)	(R)	(R)	(R)•	mGr (Xe)		am L. n. opt •Ruderal und nördl. Hügel ••Birket-Rand
				–	–		(R)	–	(R)	(R)	(R)•	(R)	(R)	–	(R)••							
292	Cucullia scrophulariae SCHIFF. 1775	–	–	–	–	–	–			–	–	2			–	–	–	–	–	Geb (mGr)	E6-A7	am L. n. opt. im Schw holz 1987/88 einige R
				–	–		–	–	–	–	–	–	–	–								
293	Calophasia lunula HUFN. 1766	–	–	1	–	–	–			–	–	–			–	1	–	–	–	Xe	M5, E7-A8	
				–	–		–	–	–	–	–	1	–	–								
294	Brachionycha sphinx HUFN. 1766	–	–	–	–	–	1			17	1	3			–	3	–	3	–	WL (Geb)	A10-A11	1983 im Berglwald 2 R
				–	5		–	2	–	9	–	4	30	1								
295	Lithophane socia HUFN. 1766	–	–	–	1	–	–			–	–	1			–	f-v	–	3	–	Geb	E9-Winter-E5	
				–	2		–	–	–	2	–	–	1	4								
296	Lithophane ornitopus HUFN. 1766	–	–	–	–	–	–			–	–	–			–	f-v	–	2	–	Geb	M3-A5	Überwinterer
				–	–		–	–	–	–	–	–	1	–								
297	Lithophane furcifera HUFN. 1766	–	–	–	1	–	–			–	–	–			–	1	–	–	–	WL (Geb)	M9-M10	Überwinterer
				–	–		–	–	–	–	–	–	–	–								
298	Xylena vetusta HBN. [1813]	–	–	–	–	–	–			–	–	1			–	2	–	–	–	mGr (Geb)	M3-M5	Überwinterer, 1989 1 ♂ am Franzosenhölzl
				–	–		1	–	–	4	1	–	–	–								
299	Allophyes oxyacanthae L. 1758	–	–	5	11	7	2			2	–	1			5	h	1	6	2	Geb (Ub, WL)	M9-E10	
				2	18		4	6	3	5	1	2	9	2								
300	Griposia aprilina L. 1758	–	–	–	–	–	–			1	–	–			–	1	–	–	–	WL (Geb)	E9-A10	
				–	–		–	–	–	–	–	–	–	–								
301	Blepharita satura SCHIFF. 1775	1	–	5	2	–	–			2	–	–			–	h	–	1	–	Geb (W)	E8-E9	
				1	8		–	–	–	2	–	–	–	–								
302	Blepharita adusta ESP. 1790	–	–	–	–	–	–			–	–	–			–	1	–	–	–	mGr (Hy)	M6	
				–	–		–	–	–	–	–	–	–	–								
303	Antitype chi L. 1758	–	–	–	–	–	–			–	–	–			–	1	–	–	–	mGr (Geb)	M8-M9	
				–	1		1	–	–	–	–	1	–	–								
304	Eupsilia transversa HUFN 1766	2	1	17	11	3	5			6	–•	2			–	h	–	6	2	Ub (WL, Geb)	E9-Winter-A5	•am nördl Hügel 1 R, ••zus 1 R
				6	1		–	2	2	6••	–	–	2	1								
305	Conistra vaccinii L. 1761	1	–	14	10	6	10			7	1	2			2	h	2	2	–	WL (Geb)	M9-Winter-M5	
				5	7		3	4	1	3	–	3	–	1								
306	Conistra rubiginosa SCOP. 1763	–	–	–	–	–	1			–	–	2			–	3•	–	–	–	Geb	E10-Winter-M4	•alle 1986
				–	1		–	–	–	–	–	–	–	–								
307	Agrochola circellaris HUFN. 1766	–	–	1	2	–	1			2	–	1			1	v-n	3	–	–	Geb	E9-E11	
				–	3		–	–	1	–	–	2	1	–								
308	Agrochola macilenta HBN. [1809]	–	–	–	3	–	–			–	–	–			1	v-h	–	–	–	Geb	M9-A11	
				1	4		1	3	–	3	–	–	–	–								
309	Agrochola nitida SCHIFF. 1775	–	–	–	1	–	–			–	–	–			–	–	–	1	–	Geb	A9-M9	
				–	–		–	–	–	–	–	–	–	–								
310	Agrochola helvola L. 1758	–	–	1	–	–	–			1	–	1			–	3	–	–	1	Geb (mGr)	E9-E10	
				1	–		–	–	–	–	–	4	–	–								
311	Agrochola litura L. 1761	1	2	2	1	–	–			–	–	2			–	v-h	–	1	–	Geb	E8-A10	
				1	4		1	–	2	2	–	1	–	–								
312	Agrochola lychnidis SCHIFF. 1775	–	–	–	–	–	–			–	–	2			–	1	1	1	1	Geb	M9-E10	
				–	–		–	–	2	–	–	–	–	–								
313	Agrochola lota CL. 1759	–	–	–	–	–	–			–	–	–			1	1	18	–	–	Geb (Hy)	E9-M10	Regattastr 1983 1 R
				1	2		1	–	–	–	–	2	–	–								
314	Parastichtis suspecta HBN. [1817] 1814	–	–	–	–	–	–			–	–	–			–	1	5	–	–	Hy (Geb)	M7-A8	
				–	–		–	–	–	–	–	–	–	–								
315	Cirrhia aurago SCHIFF. 1775	–	–	1	–	–	–			–	–	–			–	–	–	–	–	WL (Geb)	E9	
				–	–		–	–	–	–	–	–	–	–								

Nr.	Art	SIEDLUNG			WALD						HALBTROKKENRASEN			"DACHMOOS"			VOR 1987				ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
				Garten		Wasserwerk																	
		SiS	SiM	SiN	WaS	WaM	WaN	WNw	WNo	HO	HM	HW	Au	We	Mb	Gar	Mo	HO	HM			
316	Cirrhia togata ESP. 1788	–	–	– –	– –	–	5 2	2	18	– –	– –	– 1	–	2	1	–	1	–	–	Hy (Geb)	M9–M10	
317	Cirrhia icteritia HUFN. 1766	–	–	– –	– –	1	5 –	1	2	– –	4 –	2 –	–	1	–	2	3	–	–	Geb/R (Hy)	E8–A10	
318	Cirrhia gilvago SCHIFF. 1775	–	1	– –	– –	–	– –	–	–	– –	– –	– –	–	–	–	2	–	–	–	Geb	M9–E9	
319	Cirrhia ocellaris BKH. 1792	–	–	– –	– –	–	– –	–	–	– –	– –	– –	–	–	–	–	1	–	–	Geb (Hy)	M9	
320	Cirrhia citrago L. 1758	–	–	– 1	– 1	–	– 2	1	1	1 1	– –	2 1	–	–	–	v–n	–	3	1	Geb	E8–A10	
	Melicleptriinae																						
321	Chloridea viriplaca HUFN. 1766	–	–	– –	– –	–	– –	–	1	– –	– 1	– –	–	–	–	–	–	2	–	mGr/Wf (Geb/R, Xe)	E5–A7, E7–A8	auch T, 1981 in Kiesgrube 500 m von WaN entfernt 1 ♂ T
322	Chloridea peltigera SCHIFF. 1775	–	–	– –	– –	–	– –	–	–	– –	– –	1 1	–	–	–	–	–	–	–	Xe/Wf	E8–M9	
323	Pyrrhia umbra HUFN. 1766	–	–	– –	– 2	–	– –	–	–	2 1	– –	2 –	–	–	–	f–v	–	1	–	mGr (Geb, Xe)	E6–A8	
324	Panemeria tenebrata SCOP. 1763	–	(T)	– –	– –	–	– –	–	–	– –	– –	– –	–	–	–	–	–	–	–	mGr (Geb)	A5	T, 1989 3 Ex (T) im Mallertshofer Holz
325	Axylia putris L. 1761	2	6	– 3	1 24	–	75 44	6	43	3 4	1 3	8 14	6	3	1	v–h	15	–	2	Ub (Geb, Agr)	E5–E7	
	Bryophilinae																						
326	Euthales algae F. 1775	–	1	1 –*	– 4	–	2 2	–	2	1 –	1 –	4 6	–	–	–	f–h	1	1	1	Geb (WL)	E7–A9	* 1 Ex. am S-Bahnhof
327	Bryoleuca raptricula SCHIFF. 1775	–	–	– –	– –	–	– –	–	–	– –	– –	– –	–	–	–	3*	1	–	–	Xe	E7–M8	*nur 1983
	Apatelinae																						
328	Panthea coenobita ESP. 1785	–	–	– –	– 1	–	– –	–	–	– –	– –	– –	–	–	–	1	–	–	–	Geb (WN)	M6–E6	
329	Daseochaeta alpium OSBECK 1778	–	–	1 –	– –	–	– –	–	–	– –	– –	– –	–	–	–	3	–	1	–	WL (Geb)	A6–E6	
330	Colocasia coryli L. 1758	1	–	1 1	3 2	6	3 3	10	5	3 3	– –	– –	2	–	–	n–h	–*	9	–	WL	E4–M6, M7–M8	*F.F.w.r., 2. Generation 1986 bis 1988 n
331	Subacronicta megacephala SCHIFF. 1775	–	–	1 1	– –	–	1 2	–	–	– –	– –	1 3	–	5	2	2	4	1	–	Hy (Geb)	M5–M8 (2 Generationen)	
332	Acronicta aceris L. 1758	1	–	– –	3 3	–	4 2	1	–	– –	– –	2 2	–	–	–	f–v	–	2	–	Geb	E5–M8 (2 Generationen)	
333	Acronicta leporina L. 1758	2	–	2 3	– 1	–	5 2	–	–	1 –	– –	– –	–	–	–	f–v	2	–	–	Geb	E5–E7	SiN 1988 1 R
334	Apatele alni L. 1767	–	–	– –	– –	–	– –	–	1	– –	– –	– –	–	–	–	1	–	1	–	Geb	M5–A7	1989 1 ♂ (WaS)
335	Apatele psi L. 1758	–	2	2 1*	(R) 5	–	– 3	–	–	2 –	– –	1 –	–	–	–	v	T**	–	–	Geb	M5–E7, M8 (2 Ex.)	als R verbreitet, * S-Bahnhof 1 zus. Ex., **Birket-Rand
336	Hyboma strigosa SCHIFF. 1775	–	–	1 –	2 1	3	1 1	–	–	– 1	– –	– 1	–	–	2	3	–	1	–	Geb (WL)	A6–E7	
337	Pharetra auricoma SCHIFF. 1775	–	–	– –	1 3	–	11 1	–	5	– –	– 1	3 2	3	1	–	2	–	8	2	Geb/R (Agr)	E4–M5, A7–M8	in Kiesgruben (Bergl-, Schw.-holz) als R h
338	Pharetra rumicis L. 1758	–	2	– –	– 2	–	3 7	2	7	– 3	– 1	2 2	–	2	–	f–h	–	–	1	Agr (Geb/R)	A5–M6, M7–E8	
339	Craniophora ligustri SCHIFF. 1775	–	3	6 4	3 17	11	8 14	12	3	15 7	1 –	1 1	5	–	2	n–h	3	29	–	Geb (WL)	einzeln: A5–A6 häufig: E6–M8	

Nr. Art	SIEDLUNG		Garten	WALD					HALBTROKKENRASEN			"DACH. MOOS"			VOR 1987				ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
	SiS	SiM	SiN	WaS	WaM	WaN	WNw	WNo	HO	HM	HW	Au	We	Mb	Gar	Mo	HO	HM			
Jaspidiinae																					
340 Jaspidia deceptoria SCOP. 1763	–	–	–	–	–	2			1	–	2			–	–	–	1	–•	mGr (Geb)	E5-A7••	T häufiger, v.a HW und HM (Ruderal •) ••22.7.87 1 Ex
			–	–		(T)	1	3	3	2	7	1	–								
341 Jaspidia pygarga HUFN. 1766	3	7	16	47	14	285			99	3	2			12	h-sh	–	36	–	Ub (Geb, W)	M5-A8	auch T, z.B Bergwald sh
			22	127		361	417	494	102	2	10	4	8								
342 Eustrotia uncula CL. 1759	–	–	–	–	–	–			–	–	–			–	2	–	–	–	Hy	E7	
			–	–		–	–	–	–	–	–	–	–								
343 Eustrotia olivana SCHIFF. 1775	1	–	–	–	–	1			8	1	1			–	1	–	6	9	mGr (Geb, Hy)	A6-M7	T sh (ñ): HM (Ruderal •), Regattastr., Schw holz
			–	1		–	1	3	9	–•	–	–	1								
Nycteolinae																					
344 Nycteola revayana SCOP. 1763	–	–	–	1	1	–			–	–	–			–	1	–	–	–	WL	M4-A6, E7 (2 Ex.)	Überwinterer
			–	3		–	–	1	–	–	–	–	–								
Beninae																					
345 Earias chlorana L. 1761	–	–	–	–	–	3			–	–	1			1	–	–	–	–	Geb (Hy)	M6-E7	
			–	–		3	–	1	–	–	–	–	–								
346 Bena prasinana L 1758	–	–	1	3	1	6			8	–	–			–	f-h	–	5	–	WL (Geb)	M5-E7	
			5	11		21	8	5	6	–	1	1	–								
347 Pseudoips bicolorana FUESSLY 1776	–	–	–	1	–	–			–	–	–			–	3	–	–	–	WL	E6-E7	WaN 1989 2 Ex
			–	–		–	–	–	–	–	–	–	–								
Plusiinae																					
348 Chrysaspidia putnami GROTE 1873	–	–	–	–	–	–			–	–	–			–	–	1	–	–	Hy	E6	
			–	–		–	–	–	–	–	–	–	–								
349 Autographa gamma L. 1758	7	36	131	81	21	74			69	70	127			2	sh	21	13	15	Ub/Wf (Agr)	E5-A11 (2 Generationen)	auch T, z.B. Entw.gräben, Regattastr., Schw.holz sh (ñ)
			30	65		28	6	23	17	12	47	1	11								
350 Autographa pulchrina HAW. 1809	–	1	–	–	–	–			1	–	1			–	1	–	–	–	mGr• (Geb)	A6-A8	•Wf?
			–	–		–	–	–	–	–	–	–	–								
351 Autographa bractea SCHIFF. 1775	–	–	–	1	1	–			–	–	–			–	–	–	–	–	Geb• (W, Hy)	M8-E8	•Wf (RR)
			–	–		–	1	–	–	–	–	–	–								
352 Macdunoughia confusa STEPHENS 1850	–	–	3	1	–	2			–	–	4		(R)	1•	n-h	2	–	1	Agr/Wf (Xe, mGr)	M7-A10 (2 Generationen)	•auch hier 1987 1 R
			–	–		–	–	–	–	–	–	–	1								
353 Plusia chrysitis L. 1758	1	2	–	1	2	4			1	1	1			1	n-h	7	2	2	Ub	A6-E7, M8-M9•	•1988 1 Ex. der 2. Gen. schon A8
			3	12		3	7	3	5	4	7	–	–								
354 Plusia tutti KOSTR. 1961	1	–	1	3	–	1			1	–	8			–•	n	4	1	3	Ub	E5-M7, A8-E8	•Entw.graben 1 Ex.
			–	13		–	2	2	6	–	2	–	1								
355 Plusia chryson ESP. 1789	–	–	–	–	–	–			–	–	–			–	1	–	–	–	Hy (Geb)	A8	
			–	–		–	–	–	–	–	–	–	–								
356 Polychrysia moneta F. 1787	–	–	–	–	–	–			–	–	–			–	3	–	–	–	Geb	A7	
			–	–		–	–	–	–	–	–	–	–								
357 Chrysoptera c-aureum KNOCH 1781	–	–	–	1	–	–			–	–	–			–	1	–	–	–	Geb (WL)	E6-E7	
			1	–		–	–	–	–	–	–	1	–								
358 Abrostola triplasia L. 1758	–	–	–	–	–	2			1	–	–			–	3	2	–	–	Geb	E5-M8 (2 Generationen)	Gen prp.
			–	4		–	–	2	1	–	1	1	–								
359 Abrostola asclepiadis SCHIFF. 1775	–	–	1	–	–	1			–	–	–			–	–	–	–	–	Geb (Xe)	A6-E7	Gen prp.
			–	5		2	3	–	–	–	–	–	–								
360 Abrostola trigemina WERNEBG 1864	–	–	–	–	1	–			1	1	–			–	2	–	–	–	Geb	M6-E9	Gen prp.
			–	2		–	–	4	2	–	1	–	–								
Catocalinae																					
361 Astiodes sponsa L. 1767	–	–	–	–	–	–			–	–	–			–	–	–	–	–	WL•	E8	am L. n. opt •Wf (RR)
			–	1		–	–	–	–	–	–	–	–								
362 Catocala nupta L. 1767	–	–	1	1	–	–			–	1	–			–	f-v	–	–	–	Geb (WL)	A8-E9	am L. n. opt
			–	–		–	–	–	–	–	1	–	–								
363 Callistege mi CL. 1759	–	•	–	–	–	•	•	•	•	•	•	–	–	–	–	–	•	•	mGr (Agr, Geb)	M5-E6	T, auch Regattastr., Schw.holz
	–	•	–	–	–	•	•	•	•	•	–	•	–	–							

Nr.	Art	SIEDLUNG		Garten			WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"			VOR 1987				ÖKO-LO-GIE	FLUG-ZEIT	BEMER-KUNGEN
		SiS	SiM	SiN	WaS	WaM	WaN	WNw	WNo	HO	HM	HW	Au	We	Mb	Gar	Mo	HO	HM			
364	Ectypa glyphica	+	+	–	–	+	+	+	+	+	+	+	+	+	–	–	+	+	+	mGr (Geb, Agr)	A5-M7, E7 (1 Ex.)	T, auch Regattastr., Schw.holz
	L. 1758	+	+	–	–	+	+	+	+	+	+	+	+	+	–							
Ophiderinae																						
365	Scoliopteryx libatrix	1	–	–	5	–	3			–	–	1			1•	f-v	1	1	1	Geb (Hy)	E6-E7, E8-Winter-A6	am Köder besser, •zus. 1 R ••zus. 1 P
	L. 1758			–	–		1	–	1	1	–	–	–	1••								
366	Lygephila pastinum	–	–	–	–	–	7			2	–	1			–	3	–	2	–	Geb (mGr, Xe)	E6-A8•	•1988 1 Ex. M6
	TR. 1826			–	–		11	2	11	2	–	1	–	1								
367	Parascotia fuliginaria	–	–	–•	2	–	–			–	–	–			–	v-n	–	–	–	W (Geb)	E6-A9	• S-Bahnhof 1987 1 Ex.
	L. 1761			–	3		–	–	–	–	–	–	–	–								
368	Phytometra viridaria	–	–	–	–	1	–			(T)	–	–			–	–	–	–	–	mGr (W, Xe•)	A5-A6, A8-M8	auch T, Mallertshofer Holz 1989 3 Ex., • auch Moore
	CL. 1768			–	–		–	1	–	–	–	1	–	–								
369	Rivula sericealis	–	–	1	2	3	4			13	–	1			67	f-n	–	1	–	Geb (mGr)	A6-M9 (2 Generationen)	auch T (v.a. Däm)
	SCOP. 1763			3	20		8	14	22	36	–	6	1	18								
Hypeninae																						
370	Laspeyria flexula	1	1	6	25	2•	23			3	–	1			–	n-h	1	64	1	Geb (W)	M6-M8	•WaM 1987 zus. 1 R
	SCHIFF. 1775			12	71		40	34	37	2	1	1	3	6								
371	Colobochyla salicalis	–	–	–	–	–	–			–	–•	–			–	–	–	–	–•	Geb/R (Hy)	A6	v.a. T, •im Ruderal mehrere Ex
	SCHIFF. 1775			–	–		1	–	–	–	–•	–	–	–								
372	Herminia barbalis	–	–	2	1	1	1			5	–	–			–	–	–	1	–	Geb (WL)	E5-M7	
	CL. 1759			–	5		–	–	3	4	–	1	3	–								
373	Zanclognatha tarsipennalis	–	–	3	6	–	3			1	–	1			–	3	–	–	1	Geb (mGr)	M6-M8•	Gen.prp. •in 8 frische Ex. einer 2. Generation
	TR. 1835			2	48		3	3	4	–	–	–	–	–								
374	Zanclognatha tarsicrinalis	8	–	5	16	3	25			11	–	1			42	n-h	11	9	–	Geb (WL)	A6-E7•	•1987 1 Ex. am 12.8., im Birket 1985 h (T)
	KNOCH 1782			1	14		13	27	32	14	–	–	6	18								
375	Zanclognatha grisealis	–	–	–	4	–	–			–	–	–			–	2	–	–	–	Geb (WL)	A6-E7	
	SCHIFF. 1775			–	8		1	–	2	1	–	–	1	2								
376	Trisateles emortualis	–	1	–	5	2	2			2	–	–			1	v-n	–	1	–	WL (Geb)	E5-E7	
	SCHIFF. 1775			2	11		1	–	–	1	–	1	1	2								
377	Hypena proboscidalis	6•	2	5	14	–	2			2	2	1			10•	n-h	24	1	3	Ub (Geb/R)	E5-M10 (2 Generationen)	auch T: SiS + Birket h (•), 2. Gen. h
	L. 1758			13	58		2	6	7	3	–	–	25	15								
378	Hypena obsealis	–	–	–	–	–	–			–	–	–			–	–	–	–	–	Geb (Hy)	A6•	1989 1 ♂ im Franzosenhölzl, •Überwinterer
	TR. 1829			–	–		–	–	–	–	–	–	–	–								
Geometridae																						
Archiearinae																						
379	Archiearis parthenias	–	–	–	–	–	–			–	–	–			(T)	–	–	–	–	Geb (WL, Hy)	E3-E4	T, Birket und Regattastr. stets h
	L. 1761			–	–		–	–	–	–	–	–	–	(T)	(T)							
Oenochrominae																						
380	Alsophila aescularia	2•	4	57	14	–•	6			9	–	10			–	h-sh	–•	–•	–•	WL (Geb)	A3-E4	♂♂, •F.F.w.r.
	SCHIFF. 1775			8	9		7	–	2	2	–	1	29	1								
381	Odezia atrata	–	–	–	–	–	–			–	–	–			(T)	–	–	–	–	mGr (Hy)	A6-M7	T: Birket und Regattastr. n, WaM 1983 1 Ex.
	L. 1758			–	–		–	–	–	–	–	–	–	(T)								
Geometrinae																						
382	Geometra papilionaria	–	–	3	1	3	–			2	–	1			8	f-v	10	9	1	WL (Geb, Hy)	E6-M8	
	L. 1758			–	1		–	–	1	–	–	–	–	2								
383	Comibaena pustulata	–	–	–	–	–	–			–	–	–			–	–	–	4	–	WL	E6	
	HUFN. 1767			–	–		–	–	–	–	–	–	–	–								
384	Hemithea aestivaria	1	–	1	4	–	2			2	–	–			2	v-n	–	4	–	Geb (WL)	M6-M7	Raupenfunde im Ort, WaM, HO
	HBN. [1799] 1796			1	1		1	3	6	1	–	–	2	3								
385	Thalera fimbrialis	–	–	–	–	–	–			1	3	4			–	–	–	–	–	Xe (mGr)	A7-M8	
	SCOP. 1763			–	–		–	–	–	1	1	5	1	–								
386	Hemistola chrysoprasaria	–	–	–	–	–	–			–	–	–			–	–	–	–	–	Geb	E7	
	ESP. 1794			–	–		1	–	1	–	–	–	–	–								
387	Iodis lactearia	–	–	–	–	–	–			1	–	–			2•	2	–	(T:3)	–	Geb (WL)	M5-A7	Däm, am L. n. opt., •Däm 6 zus. Ex., 1983 5 Ex
	L. 1758			2	2		–	1	2	6	–	–	–	–								

Nr.	Art	SIEDLUNG		Garten	WALD		Wasserwerk			HALBTROKKENRASEN			"DACH. MOOS"			VOR 1987				ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
		SiS	SiM	SiN	WaS	WaM	WaN	WNw	WNo	HO	HM	HW	Au	We	Mb	Gar	Mo	HO	HM			
	Sterrhinae																					
388	Sterrha serpentata HUFN. 1767	-	-	- -	- -	-	- -	-	-	- -	- -	- -	-	-	-	-	-	-	-	mGr (Xe)	M7	T 1989 im Mallertshofer Holz h
389	Sterrha muricata HUFN. 1767	-	-	- -	- -	-	4 1	4	3	- 1	- -	2 -	-	-	-	-	-	-	-	mGr* (Geb)	A7-M8	*auch Moore Heiden, WaN 1978+1986 2 E
390	Sterrha biselata HUFN. 1767	-	-	5 4	12 15	-	3 13	9	8	- 6	- -	- 1	2	5	5	v-h	-	5	-	Geb (WL)	E6-M8, M9 (1 Ex.)	Entw.graben 1987 5 Ex.
391	Sterrha inquinata SCOP. 1763	-	-	- -	- -	-	- 1	-	-	- -	- -	- -	-	-	-	-	-	-	-	Geb*	M6	*v.a. an Gebäuden
392	Sterrha seriata SCHRANK 1802	-	-	1 1	- -	-	- -	-	-	- -	- -	- -	-	-	-	3	-	-	-	Geb*	E5-E6, E8-E9	*v.a. an Gebäuden, am L nicht opt., 198 S-Bahnhof 1 E
393	Sterrha dimidiata HUFN. 1767	-	-	2 1	4 10	-	3 6	4	1	- 4	- -	- -	-	1	-	-	1	1	-	Geb (Hy)	E6-E8	Entw.graben 1987 4 Ex., S-Bahnhof 198 1 Ex.
394	Sterrha emarginata L. 1768	-	-	- -	- -	-	- -	-	-	- -	1 -	- -	-	-	-	1	-	-	-	Geb (Hy)	M7-A8	
395	Sterrha aversata L. 1768	1	3	11 24	22 84	8	12 9	20	14	11 9	2 -	9 7	2	5	6	h	1	25	-	Ub (Geb, WL)	E5-E7, E7-M9	2. Generation weniger zahlreich
396	Cyclophora albipunctata HUFN. 1767	-	-	- 1	- 2	-	- 4	1	-	- 3	- -	- -	-	5*	4	f-n	1	1	-	WL (Geb)	A5-E6, E7-M8	Däm, Birket 1983 2 Ex, *Däm h
397	Cyclophora punctaria L. 1768	-	-	5 40	19 220	3	2 20	19	15	29 65	- -	3 9	7	1	5	h-sh	-	44	-	WL (Geb)	A5-A7, M7-E8, A9-M9	3. Generation nur sehr partiell
398	Cyclophora linearia HBN. [1799] 1796	-	-	- 2	- -	1	- -	-	-	- 1	- -	- -	-	-	-	2	-	-	-	WL (Geb)	M5-E6, A8-E8	1989 WaN 1 ♀
399	Calothysanis griseata PETERSEN 1902	-	-	3 4	3 19	3	3 10	16	8	9 10	(T) -	9 2	4	1	8	v-h	2	14	3	Ub (Geb, Hy)	M5-E6, M7-E9	auch T, Birket 1981/83 3 Ex Entw.graben 1987 2 Ex. u.s
400	Scopula immorata L. 1768	-	-	- -	- -	-	- -	1	1*	1 1	3 2	10 47	-	-	-	-	-	(T)	3	mGr (Xe)	E5-A7, E7-A9	auch T: HO '8 87 v, HM '86 WNo T 2 Ex., 2. Gen. stärke
401	Scopula nigropunctata HUFN. 1767	-	-	- 1	4 1	3	10 5	10	14	6 3	- -	- 1	-	3	8	3*	-	8	-	WL (Geb, Hy)	M6-A8 (1988 1 Ex. E5)	*im bewaldet Teil, Schw.hol. 1987 T 1 Ex.,
402	Scopula ornata SCOP. 1763	-	-	- -	- -	-	- 1	-	-	- -	6 2	2 3	-	-	-	1	-	1	-	Xe (mGr)	E5-A7, A8-A9	auch T: HW 1987 1 Ex
403	Scopula rubiginata HUFN. 1767	-	-	- -	- -	-	- 2	-	1	- 1	- 1	6 9	-	-	-	-	-	1	2	Xe	M6-E6, A8-E8	auch T, 2. Generation stärker
404	Scopula immutata L. 1768	-	-	- -	- -	-	- -	-	-	- -	- -	- -	-	-	-	1	-	-	-	Hy (mGr)	A7	
405	Scopula lactata HAW. 1809	-	-	1 -	- -	-	- 2	2	-	- -	- -	- -	-	-	-	1	-	(T)	-	Geb (mGr)	E5-E6	auch T
	Larentiinae																					
406	Scotopteryx chenopodiata L. 1768	1	-	1 2	1 8	12	143 140	119	218	13 26	1 -	37 60	2	-	-*	2	-	9	5	mGr (Geb)	M7-A9	*Birket-Rand 8 Ex, auch T: WaN, HO+HM Ruderal h-sh
407	Anaitis praeformata HBN. [1826]	-	-	- 1	- -	-	1 -	-	-	- -	- -	- -	-	-	-	-	-	-	-	Xe (Geb)	A8-E8	
408	Anaitis efformata GN. 1857	3	15	10 5	10 39	-	3 5	1	4	5 1	- 2	63 28	1	2	-	n-h	-	9	1	mGr (Xe, Agr)	M5-A7, E7-A10	Gen.prp. auch T (v) S-Bahnhof 1988 1 Ex
409	Acasis viretata HBN. [1799] 1796	-	-	- -	- -	1	- -	-	1	- -	- -	- -	-	-	-	2	-	1	-	Geb (WL)	A5-A6	1989 wieder an SiN 1 Ex.
410	Nothopteryx polycommata SCHIFF. 1776	-	-	1 -	- 2	-	- 1	-	-	1 -	- -	1 -	-	-	-	v-n	-*	-*	-*	Geb	E3-M4	*F.F.w.r.
411	Nothopteryx carpinata BKH. 1794	-	-	- -	- -	-	1 -	1	1	1 -	- -	- -	-	4	1	-	-*	-	-	Geb	M4-M5	*F.F.w.r.
412	Lobophora halterata HUFN. 1767	-	-	- 1	- -	-	- -	-	-	- -	- -	- -	-	1	-	-	-*	-	-	Geb	A5-M5	*F.F.w.r.
413	Pterapherapteryx sexalata RETZ. 1783	1	4	1 -	- -	-	8 7	-	4	1 -	1 8	1 4	1	-	9	1	-	1	3	Geb/R (Hy, mGr)	M5-A8	
414	Operophthera brumata L. 1768	(R)	-	13 65	3 105	2	- 8	7	-	1 18	1 -	(R) 3	22	8	-*	h-sh	-*	6	-	WL (Geb)	E10-A12	♂♂, *F.F.w.r

Nr.	Art	SIEDLUNG SiS	SIEDLUNG SiM	Garten SiN	Garten WaS	WALD WaM	Wasserwerk WaN	Wasserwerk WNw	Wasserwerk WNo	HALBTROKKENRASEN HO	HALBTROKKENRASEN HM	HALBTROKKENRASEN HW	"DACHMOOS" Au	"DACHMOOS" We	"DACHMOOS" Mb	VOR 1987 Gar	VOR 1987 Mo	VOR 1987 HO	VOR 1987 HM	ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
415	Oporinia dilutata SCHIFF. 1776	–	–	5	16	–	1			15	–	–			–	h	1	4	–	WL (Geb)	A10–A11	Gen.prp.
				14	49		1	4	7	7	–	1	2	5								
416	Oporinia autumnata BKH. 1794	–	–	3	5	2	1			3	–	–			9	v–n	4	–	–	Hy (WL, Geb)	A10–M11	Gen.prp.
				1	8		2	1	2	8	–	2	1	1								
417	Triphosa dubitata L. 1758	1	–	–	5	1	1			1	–	1			2	n	–	–	1*	Geb**	M7–Winter–E5	*am Sendergebäude, **v.a. an Gebäuden
				1	3		1	–	–	1	–	–	1	–								
418	Calocalpe cervinalis SCOP. 1763	–	–	18	15	11	4			6	–	1			–	h–sh	–*	11	–	Geb (WL)	E3–A6	*F.F.w.r.
				6	29		7	5	3	7	–	–	–	–								
419	Philereme vetulata SCHIFF. 1775	2	–	1	9	1	4			11	1	8			7*	f–h	–	46	3	Geb (Ub)	E6–E7	*Birket 1987 T 2 Ex., Garten erst ab 1986
				13	39		3	6	9	6	1	12	1	18								
420	Philereme transversata HUFN. 1767	–	–	–	1	–	–			–	–	–			–	v–h	–	2	–	Geb*	E6–M8	*v.a. an Gebäuden
				–	15		–	1	1	1	–	–	–	–								
421	Lygris prunata L. 1758	–	–	–	2	–	–			1	–	–			–	f–n	–	–	–	Geb*	M6–A9	*v.a. Gärten
				–	31		–	–	1	1	–	–	–	–								
422	Lygris testata L. 1761	–	–	–	–	–	–			–	–	–			–	–	–	–	–	Hy (Geb)	A8	
				–	–		1	–	–	–	–	–	1	1								
423	Lygris populata L. 1758	–	–	–	–	–	–			–	–	–			–	–	–	–	–	W (Geb)		1988 3 Ex. im Korbinianiholz. KOLBECK, WaS 1989 1 ♂
				–	–		–	–	–	–	–	–	–	–								
424	Lygris mellinata F. 1787	–	–	–	–	–	–			–	–	–			–	f–v	–	1	–	Geb*	M6–A7	*v.a. Gärten
				–	6		–	–	–	–	–	–	–	–								
425	Lygris pyraliata SCHIFF. 1775	3	–	1	5	2	9			9	–	11			1	v	1	4	–	Geb (mGr)	E6–M8	
				2	12		10	13	17	4	–	14	–	3								
426	Cidaria fulvata FORSTER 1771	–	3	2	8	–	12			1	–	2			–	v–n	–	–	1	Geb	M6–E7	
				2	29		4	9	6	1	–	1	–	–								
427	Plemyria rubiginata SCHIFF. 1775	2	3	2	11	–	4			1	–	2			1*	f–v	–	1	–	WL (Geb, Hy)	E6–E7**	*T ein zus. Ex., **1987 1 Ex. M8
				3	26		5	1	3	–	1	4	2	4								
428	Thera variata SCHIFF. 1775	–	1	4	10	–	5			3	–	5			1	n–h	2	1	–	WN (Geb)	M5–A7, M8–E9, M10 (2 Ex.)	Gen.prp., keine T. britannica
				3	16		4	4	2	1	–	3	2	–								
429	Thera obeliscata HBN. 1787	–	–	8	3	1	11			1	–	–			–	h	–	38	1	WN (Geb)	E5–E7, E7–A8*	*regelmäßig frische Ex., jedoch 1. Gen stärker
				10	16		24	18	14	5	–	2	–	–								
430	Thera juniperata L. 1758	13	–	2	8	–	3			–	–	2			–	h	–	–	–	Geb (WN)	E9–E10	S-Bahnhof 1987 6 Ex.
				7	9		2	–	–	–	–	1	–	–								
431	Thera firmata HBN. [1822]	–	–	86	52	1	13			26	1	8			–	h–sh	–	17	3	WN (Geb)	M8*–M10	*A8 einzeln
				11	21		3	12	2	11	–	3	1	–								
432	Chloroclysta siterata HUFN. 1767	–	–	1	2	1	1			–	–	2			–	v–h	–	4	–	Geb (WL)	M8–Winter–M6	
				1	2		1	1	–	–	–	1	1	–								
433	Dystroma truncata HUFN. 1767	–	–	8	19	4	4			7	1	1			21*	n–h	1	1	–	Geb (W)	E5–M7, M8–E10 (A8 2 Ex.)	*Birket 1983 1 Ex., M–E10 z.T. frische Ex., Gen.Prp
				5	69		1	9	5	3	–	5	12	7								
434	Dystroma citrata L. 1761	–	–	1	2	–	–			–	–	–			–	–*	–	–	–	Geb (W, Hy)	A8–E9	*vor 1987 4 fotogr. Belege, sonst übersehen, Gen.Prp.
				2	27		3	2	1	–	–	–	–	–								
435	Xanthorhoe fluctuata L. 1758	–	3	(T:1)	14	2	–			1	–	2			–	n–h	1	1	–	Geb (Agr)	A5–E6, M7–E9, M10 (1 Ex.)	
				6	45		–	4	1	–	–	7	2	–								
436	Xanthorhoe montanata SCHIFF. 1775	–	–	–	–	–	–			1	–	–			20*	1	1	1	–	W (Hy)	A6–M7	T, *am L. n. opt.: Birket 1987 T > 500 Ex.
				–	5		–	–	–	–	–	–	1	(T)								
437	Xanthorhoe spadicearia SCHIFF. 1775	–	1	11	10	9	21			10	2	18			5	v–h	–	1	–	Geb (W, Ub)	A5–E6, A7–E8	Gen.Prp., auch T: Birket-Rand 1987 3 Ex., 1988 1 Ex.
				11	33		56	41	111	15	1	13	3	6								
438	Xanthorhoe ferrugata CL. 1759	1	13	48	85	7	39			52	5	41			12	sh	5	25	4	Ub (Geb)	A5–M6*, A7–M9**	*1987 bis E6, **in 9 z.T. frisch Gen.prp., auch T: Birket-Rand n
				47	621		42	19	29	29	2	22	16	4								
439	Xanthorhoe biriviata BKH. 1794	–	–	–	2*	–	–			–	–	–			–	–	–	–	–	W (Geb, Hy)	M4–A5, E6–E7	*zus. 1 R, **T 2 zus. Ex
				–	5		–	–	–	–	–	–	1	2**								
440	Xanthorhoe designata HUFN. 1767	–	–	–	1	–	–			–	–	–			–	–	–	–	–	W (Hy)	E5, M7–M8	SiN E5 1989 1 frisches ♀
				–	3		–	–	–	–	–	–	–	–								
441	Ochyria quadrifasciata CL. 1759	1	2	7	44	9	7			19	1	5			–	h	–	7	–	W (Geb)	M6–E8*	*1987 1 Ex. A9, Entw.graben 1987 1 Ex.
				14	201		9	9	9	16	–	2	5	2								

Nr	Art	SIEDLUNG SiS	SiM	Garten SiN	WALD WaS	Wasserwerk WaM	WaN	WNw	WNo	HALBTROKKENRASEN HO	HM	HW	"DACH. MOOS" Au	We	Mb	VOR 1987 Gar	Mo	HO	HM	ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
442	Nycterosea obstipata F. 1794	–	–	1 –	– –	–	– –	–	–	– –	– –	– –	–	–	–	–	–	–	–	Ub/Wf	A11	
443	Calostigia olivata SCHIFF. 1776	–	–	1 1	1 8	1	1 –	1	–	– –	– –	– –	–	–	–	2	–	–	–	W	M7-A8	
444	Calostigia pectinataria KNOCH 1781	–	1	2 2	7 22	4	11 5	5	7	2 2	– 1	4 7	–	–	–	3	–	5	1	Geb (mGr)	A6-E7, E8*	* 1 Ex. 1989
445	Lampropteryx ocellata L. 1758	1	–	– 1	3 21	–	1 1	4	15	2 3	– –	4 7	1	1	–	f-v	–	–	–	mGr (Geb)	M5-A7, E7-A9	Birket 1983 1 Ex.
446	Lampropteryx suffumata SCHIFF. 1776	–	–	– 1	– 1	–	2 2	1	4	1 2	– –	– –	–	–	–	f-v	–	–	–	Geb (W)	A5-M6	
447	Coenotephria berberata SCHIFF. 1776	–	–	5 13	18 119	4	7 5	1	6	7 12	1 –	7 2	1	–	2	h	–	3	–	Geb (W)	A5-A7, M7-A9	
448	Euphyia cuculata HUFN. 1767	–	1	2 4	7 5	3	4 10	10	9	5 2	2 1	1 4	–	–	–	f-n	–	–	–	Geb (mGr, W)	A6-A8	
449	Euphyia molluginata HBN. [1813] 1796	–	–	– –	1 2	–	– –	1	–	– –	– –	– –	–	–	–	1	–	–	–	Geb (mGr)	E6-E7	WaN 1989 1 Ex
450	Euphyia bilineata L. 1758	(T:1)	1	8 –	7 48	4	3 4	1	–	10 7	1 –	16 13	2	–	–	n-h	–	20	1	Ub (Geb, mGr)	A6-E9 (1-2 Generationen)	auch T: HO + HM-Ruderal stets h
451	Diactinia capitata H.-S. 1839	–	–	– –	– 1	–	– –	–	–	– –	– –	– –	–	2	–	–	–	–	–	Hy (Geb, W)	E6-M7	We 1989 1 Ex
452	Diactinia silaceata SCHIFF. 1776	–	–	– 2	– 12	2	– –	2	1	– –	– –	– –	2	–	20*	3	–	1	–	W (Hy)	A5-A6, A7-M8	auch T/Däm *Birket 2 Ex
453	Electrophaes corylata THNBG. 1792	–	–	– 1	– 4	–	– 4	–	1	– 1	– –	– 1	–	–	2	f-h	–	3	–	WL (Geb)	E5-A7	
454	Mesoleuca albicillata L. 1758	–	–	1 –	– 6	(T)	– –	–	–	– –	– –	– –	–	8	13	f-v	–	–	–	W (Hy)	M5-E8	auch T/Däm: Birket + We stets h, 1988 Schw.holz 1 Ex
455	Melanthia procellata SCHIFF. 1776	–	–	– –	– 3	–	– –	1	1	– –	– –	– –	–	–	–	2	–	–	–	Geb (Xe)	A6-A7, E7-M8	
456	Epirrhoe tristata L. 1758	4	2	– 2	1 6	–	111 86	28	33	3 4	– 2	18 50	1	1	1 (T*)	f-v	–	5	–	mGr (Geb)	A5-M7, M7-E8	auch T, v.a WaN und HW, *Entw.graben T 11 Ex.
457	Epirrhoe alternata MÜLLER, O.F. 1764	4	5	11 27	12 196	2	26 115	55	109	10 31	1 4	31 59	20	28	14 (T:6)	h	sh	3	1	Ub (Geb)	E4-A9* (2-3 Generationen)	auch T überall h *In 9 z.T. frische Ex
458	Perizoma alchemillata L. 1758	1	9	8 25	5 51	1	9 11	7	6	12 12	– 1	21 38	6	1	9	h	sh	2	1	Ub (Geb)	M6-E8	
459	Perizoma bifaciata HAW. 1809	–	–	– –	– 1	–	– –	–	–	– –	– –	– –	–	–	–	–	–	–	–	Xe (mGr, Geb)	M8	
460	Perizoma blandiata SCHIFF. 1776	–	–	– –	– –	–	– –	–	–	– –	– –	– –	–	–	–	2	–	–	–	Hy (Geb)	A6-E6	
461	Perizoma flavofasciata THNBG. 1792	–	–	– –	– –	–	– –	–	2	1 –	– –	– –	–	–	–	1	–	–	–	Geb (mGr)	A6-M7	
462	Hydriomena furcata THNBG. 1784	2	–	– 1	3 3	–	11 8	8	4	2 2	– –	1 2	3	15	6	1	sh	2	–	Geb (W, Hy)	E6-A8	
463	Hydriomena coerulata F. 1777	–	–	– 1	3 3	–	3 13	4	7	11 6	– –	2 –	–	3	35	n	–	4	–	Geb (Hy)	A5-M7	Birket 1983 3 Ex.
464	Anticlea badiata SCHIFF. 1776	–	–	– –	– –	–	1 1	3	1	– –	– –	– –	–	–	–	–	–	–	–	Geb	E3-E4	1989 WaS 1 ♂
465	Pelurga comitata L. 1758	–	–	– –	– 1	–	– –	–	–	– 1	– –	3 –	–	–	1	2	–	–	–	mGr (Agr, Geb/R)	E7-E8	
466	Hydrelia testaceata DONOVAN 1810	–	–	– –	1 –	–	1 –	–	1	– –	– –	– –	3	10	53	–	–	–	–	Hy (Geb)	E6-A8	WaN 1989 1 Ex., im Franzosenhölzl sh
467	Hydrelia flammeolaria HUFN. 1767	–	–	1 2	1 31	2	6 3	7	3	3 8	– –	– 1	2	3	16	–	–	3	–	WL (Geb, Hy)	M6-A8	
468	Euchoeca nebulata SCOP. 1763	–	–	2 1	2 3	–	9 4	13	12	10 21	– –	1 –	5	18	30	–	–	3	–	WL (Hy, Geb)	M5-A7, A7-E8	1. Gen. 1987 bis M7, 2. Gen. zahlreicher

Nr.	Art	SIEDLUNG SiS	SIEDLUNG SiM	Garten SiN	Garten WaS	WALD WaM	Wasserwerk WaN	Wasserwerk WNw	Wasserwerk WNo	HALBTROKKENRASEN HO	HALBTROKKENRASEN HM	HALBTROKKENRASEN HW	"DACHMOOS" Au	"DACHMOOS" We	"DACHMOOS" Mb	VOR 1987 Gar	VOR 1987 Mo	VOR 1987 HO	VOR 1987 HM	ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
469	Asthena albulata HUFN. 1767	–	–	– –	– 7	–	– 1	–	–	– 2	– –	– –	–	–	–	–	–	–	–	Geb (WL)	E5-A7	im Garten (WaS) auch 1989
470	Asthena anseraria H.-S. 1856	–	–	– –	– –	–	– 1	2	–	– –	– –	– –	–	–	–	–	–	–	–	Geb (W)	A6-A7	
471	Eupithecia tenuiata HBN. [1813] 1796	1	–	1 1	– 1	–	– 2	2	3	– 2	– –	1 5	–	–	–	1	–	–	1	Geb/R	E7-E8	Gen.prp.
472	Eupithecia inturbata HBN. [1817] 1814	–	1	1 1	1 –	–	– 7	–	–	– 2	– –	1 –	1	1	–	–	–	–	–	Geb	E7-E8	Gen.prp.
473	Eupithecia plumbeolata HAW. 1809	–	1	1 –	2 1	–	– –	–	–	– –	– –	– –	–	–	–	–	–	–	–	Geb (mGr)	A7-A8	Gen.prp.
474	Eupithecia pini RETZ. 1783	–	–	– –	1 –	–	– –	–	–	– –	– –	– –	–	–	–	–	–	–	–	WN	E5-M6	Gen.prp., WaS 1989 1 Ex.
475	Eupithecia bilunulata ZETT. [1839]	–	–	– –	– –	–	– –	–	–	– –	– –	– –	–	–	–	3*	–	–	–	WN	A5-M5	*alle 1983, Nachzucht, WaS 1989 1 Ex, Gen.prp.
476	Eupithecia linariata SCHIFF. 1775	–	–	– –	– 1	–	– –	–	–	– –	– –	2 1	–	–	–	–	–	–	–	Agr (mGr, Geb/R)	A7-E8	Gen.prp
477	Eupithecia exiguata HBN. [1813] 1796	–	–	3 4	7 17	–	– 1	–	2	3 –	– –	– –	3	–	1	n-h	–*	1	–	Geb (WL)	A5-M6	Gen.prp. *F.F.w.r.
478	Eupithecia valerianata HBN. [1813] 1796	1	–	– –	1 –	–	– –	–	–	– 3	– –	– –	–	–	–	–	–	–	–	Hy (Geb, WL)	E6-M7	Gen.prp.
479	Eupithecia venosata F. 1787	–	–	– –	1 2	–	– –	–	2	– –	– –	– 1	–	–	–	1	–	–	–	Geb (Xe)	M6-E7	
480	Eupithecia egenaria H.-S. 1848	–	–	1 –	– –	–	– –	–	–	1 –	– –	– –	1	–	–	–	–	–	–	Geb (WL)	M6-M7	Gen.prp.
481	Eupithecia extraversaria H.-S. 1852	–	–	– 1	1 –	1	1 2	–	3	– 1	– –	2 1	–	1	–	–	–	–	–	Geb (Xe, W)	A7-E7	Gen.prp.
482	Eupithecia centaureata SCHIFF. 1775	–	–	– –	– 1	–	– 1	1	1	– –	2 1	7 8	–	–	–	v	1	5	–	mGr (Geb, Agr)	M5-A6, E7-E8	
483	Eupithecia selinata H.-S. 1861	–	–	1 1	– 1	1	– 1	–	1	– –	– –	– –	–	1	–	–	–	–	–	WL (Geb)	E6-E7	Gen.prp.
484	Eupithecia trisignaria H.-S. 1848	–	–	– –	– –	–	– 1	2	–	1 –	1 –	– –	–	1	–	f-v	–	–	–	Geb (mGr)	A5-M5, A7-E7	Gen.prp.
485	Eupithecia intricata ZETT. [1839]	–	–	5 27	28 113	–	1* 1	2	1	– 1	– –	– –	–	–	–	f-n**	–	–	1	Geb (Xe)	A5-E6	Gen.prp. *zus. T 1 Ex. **nur 1986
486	Eupithecia satyrata HBN. [1813] 1796	–	–	– –	1 2	–	2* –	1	1	– –	– –	5 3	–	1	1	f-h**	–	–	–	Geb (mGr)	E5-E6	Gen.prp. *zus. 3 R **nur 1986
487	Eupithecia tripunctaria H.-S. 1852	1	2	7 3	8 16	2	– 2	1	1	– 1	– –	3 –	3	–	1	f-n*	–	(R)	–	Geb (mGr, W)	M5-A6, M7-E8	Gen.prp. *nur 1986, 2. Generation stärker
488	Eupithecia absinthiata CL. 1759	–	–	– –	– 3	–	– 1	1	–	– –	– –	– 2	–	–	–	3	–	–	–	Geb (mGr, W)	A8-E8*	Gen.prp. *1987 1 Ex. E6
489	Eupithecia assimilata DOUBLEDAY 1856	–	–	– 1	1 4	–	– –	–	–	– –	– –	– 2	–	–	–	1	–	–	–	Geb* (mGr)	M5-A6, E7-E8	Gen.prp. *v.a. Gärten, 2. Generation stärker
490	Eupithecia vulgata HAW. 1809	–	–	– 4	5 45	–	– –	–	–	– –	– –	– 2	–	–	–	f-v	–	–	–	Geb (mGr)	M5-A7	Gen.prp.
491	entfällt																					
492	Eupithecia castigata HBN. [1813] 1796	1	5	7 13	12 37	–	15 21	6	11	3 5	– –	4 4	2	–	5*	h	–	1	1	Ub (Geb)	A5-E7	Gen.prp. *T 2 weitere Ex.
493	Eupithecia icterata VILL. 1789	–	–	1 1	1 4	1	3 10	7	3	1 5	– –	3 3	2	–	1	–	1	2	–	Geb (mGr)	M7-E8	Gen.prp
494	Eupithecia succenturiata L. 1758	–	–	3 –	– –	–	7 –	2	2	2 1	– –	2 1	1	–	–	f-h	–	1	–	Geb (mGr)	A7-E8	Gen.prp.
495	Eupithecia subumbrata SCHIFF. 1775	–	–	– –	– –	–	4 1	1	5	2 3	1 1	3 9	–	–	–	–	–	–	–	mGr (Geb)	E5-M7	Gen.prp.
496	Eupithecia millefoliata RÖSSLER 1866	–	–	– –	– –	–	– –	–	1	1 1	– –	– 1	–	–	–	–	–	–	1	Xe (mGr, Geb)	A7-A8	Gen.prp.

Nr	Art	SIEDLUNG		Garten		WALD	Wasserwerk			HALBTROKKENRASEN			"DACH. MOOS"			VOR 1987				ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
		SiS	SiM	SiN	WaS	WaM	WaN	WNw	WNo	HO	HM	HW	Au	We	Mb	Ger	Mo	HO	HM			
497	Eupithecia sinuosaria EV. 1848	-	-	- -	- 4	-	- -	-	-	- -	- -	- -	-	-	-	-	-	-	-	mGr/R (Agr)	M6-E7	
498	Eupithecia indigata HBN. [1813] 1796	-	-	1 1	2 5	1	1 -	-	1	- -	- -	- -	-	-	-	n-h	-*	1	-	WN	A5-E5	Gen.prp *F.F.w.r. Birket 1983 1 Ex.
498 a	siehe Addenda																					
499	Eupithecia innotata HUFN. 1767	-	-	- -	- 1	-	- -	-	-	1 -	- -	1 1	-	-	-	3*	-	-	-	mGr (Geb)	A8-E8	Gen.prp. *nur 1986
500	Eupithecia virgaureata DOUBLEDAY 1861	-	1	2 7	7 28	4	- 5	3	2	1 7	- -	2 2	3	3	3	2	-	-	-	Ub (Geb, W)	E4-A6, E7-A9	Gen.prp.
501	Eupithecia abbreviata STEPH. 1831	-	-	- -	- -	-	- -	-	-	- -	- -	- -	-	-	-	-	-	-	-	WL		1989 1 Ex. im Korbinianiholz KOLBECK
502	Eupithecia dodoneata GN. 1857	-	-	- -	- -	-	- -	-	-	- -	- -	- -	-	-	-	-	-	-	-	WL	A5-M5	1989 an SiN + WaS 3 ♀♀ Gen.prp.
503	Eupithecia sobrinata HBN. [1817]	-	-	- -	- -	-	- -	-	-	- -	- -	- 1	-	-	-	f-h	-	-	-	Geb	E7-E8	Gen.prp.
504	Eupithecia lariciata FRR. 1842	-	-	- -	1 1	1	- -	-	-	2 -	- -	- -	-	-	-	-	-	-	-	WN	A6-M7	Gen.prp.
505	Eupithecia tantillaria BSD. 1840	-	1	6 5	11 19	7	3 1	5	2	3 4	- -	1 1	-	-	1	v-h	-	2	-	WN (Geb)	A5-A7	Gen.prp
506	Eupithecia lanceata HBN. [1826] 1816	-	-	2 2	1 5	2	- 4	12	4	- -	- -	- -	-	-	-	f-n	-*	-	1	WN (Geb)	M4-M5	Gen.prp. *F.F.w.r
507	Chloroclystis v-ata HAW. 1809	7	2	6 12	11 32	9	6 10	14	12	14 7	1 -	2 4	4	4	8	h	-	1	-	Ub (Geb, Hy)	E4-M6, E6-M8	Gen.prp
508	Calliclystis chloerata MABILLE 1870	1	-	1 -	1 -	-	- 1	1	-	- -	- -	- -	1	-	-	-	-	-	-	Geb	M6-A8	Gen.prp., im Garten (WaS) 1989 wieder 1 Ex.
509	Calliclystis rectangulata L. 1758	5	2	17 17	7 29	1	- 2	-	5	2 4	- -	6 9	-	1	4	h	-	6	1	Ub (Geb, Agr)	M6-E7*	Gen.prp. *1983: E5-E6
510	Horisme tersata SCHIFF. 1775	-	-	1 1	- 8	1	1 1	1	2	- -	- -	- -	-	-	-	-	-	-	-	Geb (W)	E6-E7	
	<u>Boarmiinae</u>																					
511	Arichanna melanaria L. 1758	-	-	- -	- -	-	- -	2	-	- -	- -	- -	-	-	-	-	-	-	-	Hy	A7	
512	Abraxas grossulariata L. 1758	-	-	- -	- -	-	- -	-	-	- -	- -	- -	-	1	-	-	-	-	-	Geb*	M7	*v.a. Gärten, We 1989 1 ♂
513	Calospilos sylvata SCOP. 1763	1	-	- -	- 4	-	- -	-	-	2 3	- -	- 1	9	717*	512*	-	-	3	-	Geb (WL)	M6-E8	*auch T (zahlreich)
514	Lomaspilis marginata L. 1758	9	1	6 4	2 7	4	48 51	31	44	9 5	4* 3*	8 5	16	71	31*	n	145	20	18	Ub (Geb, Hy)	A5-M8**	*auch T: Birke Entw.graben un HM-Ruderal v, **1987 1 Ex. E
515	Ligdia adustata SCHIFF. 1775	2	1	2 3	8 18	1	3 4	6	5	1 5	- -	1 -	8	2	4	v-h	1	1	-	Geb	A5-A7, A7-E8	
516	Bapta bimaculata F. 1775	-	-	- -	1 9	1	- -	2	5	3 2	- -	- -	7	11	8*	v-h	-	1	-	WL (Geb, Hy)	A5-A7	*Däm: Birket 1981/87 je 1 Ex
517	Bapta temerata SCHIFF. 1775	2	1	7 8	4 32	5	10 15*	26	12	4 17	- 1	3 2	14	24	9	n-h	-	9	-	WL (Ub, Geb)	A5-M7, M8 (1 Ex.)	*T ein weitere Ex.
518	Cabera pusaria L. 1758	1	-	9 11	17 37	-	27 17	17	35	8 5	1 -	2 1	6	16	13	n-h	-	1	-	Geb (WL)	A5-E8 (am Flugzeitende z.T. frisch)	Gen.prp., auch T: HO 1986/87, Birket je 1 Ex
519	Cabera exanthemata SCOP. 1763	2	2	4 3	5 16	4	37 25	21	42	11 10	3 5	- 3	1	30	49	f-n	9	7	1	Ub (Geb)	A5-E8 (2 Generationen)	Gen.prp., auch T/Däm v.a. im Dach. Moos h
520	Plagodis dolabraria L. 1767	-	-	1 2	1 5	-	1 2*	2	1	7 4	- -	- -	-	-	-	v-h	-	10	-	Geb	M5-E6	*1 weiteres Ex. (T)
521	Ellopia fasciaria L. 1758	-	-	- -	- -	-	- -	-	-	- -	- -	1 -	-	-	-	f-v	-	1	-	WN (Geb)	M6-M7	sensu FORSTER & WOHLFAHRT
522	Ellopia prasinaria SCHIFF. 1775	-	-	- -	- 1	-	- -	3	-	- 2	- -	- -	-	-	-	v-n	-	4	-	WN (Geb)	A6-A7	sensu FORSTER & WOHLFAHRT
523	Campaea margaritata L. 1767	2	-	- 1	- 16	-	1 -	-	3	- 1	- -	- 2	1	-	-	v-n	-	3	-	WL (Geb)	A6-E7, A9-M9	

Nr.	Art	SIEDLUNG SiS	SIEDLUNG SiM	Garten SiN	WALD WaS	Wasserwerk WaM	Wasserwerk WaN	Wasserwerk WNw	Wasserwerk WNo	HALBTROKKENRASEN HO	HALBTROKKENRASEN HM	HALBTROKKENRASEN HW	"DACH. MOOS" Au	"DACH. MOOS" We	"DACH. MOOS" Mb	VOR 1987 Gar	VOR 1987 Mo	VOR 1987 HO	VOR 1987 HM	ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
524	Ennomos autumnaria WRNBG. 1859	–	–	– 1	– 1	1	– –	–	–	– –	– –	1 –	–	–	–	3	–	–	–	Geb (WL)	E8–E10	
525	Deuteronomos alniaria L. 1758	–	–	– –	– –	–	– 1	–	–	– –	– –	1 –	–	–	–	1	–	–	1	Geb (WL)	M8–A9	
526	Deuteronomos fuscantaria HAW. 1809	–	–	– –	– –	–	– –	–	–	1 –	– –	1 –	–	–	–	v–n	–	–	–	Geb	E7–M9	
527	Deuteronomos erosaria SCHIFF. 1775	1	1	4 1	1 –	–	1 –	–	–	3 –	– –	– –	–	–	1	v–h	2	23	1	WL (Geb)	M7–M9	
528	Selenia bilunaria ESP. 1795	1	–	1 4	5 21	3	– 1	1	–	– –	1 –	– 2	5	1	1	n–h	–	5	–	WL (Geb)	M4–M5, A7–A8	
529	Selenia tetralunaria HUFN. 1767	–	–	3 3	5 7	1	3 5	2	1	– 5	– 1	1 –	5	1	2	v–n	1	14	1	WL (Geb)	M4–E5, M7–M8	
530	Apeira syringaria L. 1758	–	–	1 –	1 3	1	1 1	1	–	1 1	– –	– –	–	–	–	2	1	–	–	Geb (WL)	A7–M8	
531	Gonodontis bidentata CL. 1759	–	1	– 2	1 10	2	3 3	–	1	4 3	– –	– –	1	–	–	v	–	1	–	Geb (WL)	A5–M6	
532	Colotois pennaria L. 1761	–	1	2 2	2 20	–	– 3	–	–	4 4	– –	4 –	8	32	7	h	3	3	–	Geb (WL)	E9–A11	
533	Crocallis elinguaria L. 1758	1*	–	4 3	8 58	–	2 4	5	2	1 9	– –	1 1	2*	3	–	n–h	18	2	2	Geb (WL)	A7–M8	*zus. je 1 R
534	Angerona prunaria L. 1758	–	–	– –	– –	–	1 –	2	1	– 2	– –	– –	1	7	5	–	–	2	–	Geb (WL)	E6–E7	WaS 1989 1 ♂
535	Ourapteryx sambucaria L. 1758	1	–	– –	– 5	–	– –	–	–	2 –	– –	– 1	–	–	1	v–n	1	–	–	WL (Geb)	E6–E7	
536	Opisthograptis luteolata L. 1758	–	–	1 1	7 5	3	2 2	–	3	2 1	– 1	1 3	3	2	2	n–h	–	4	1	Geb (WL)	A5–E6*	*1987 1 Ex. M7, auch Dam
537	Epione repandaria HUFN. 1767	–	–	– –	– 1	–	4 2	4	1	1 3	– 2	– –	–	11	2	–	2	–	3	Geb/R (Hy)	M6–E9 (2 Generationen)	
538	Cepphis advenaria HBN. 1790	–	–	– –	– –	–	– –	–	–	– –	– –	– –	1	7	15*	–	–	–	–	W (Hy)	E5–E6	*Birket 1983 2 Ex., auch T: Birket stets h
539	Lozogramma chlorosata SCOP. 1763	–	–	– –	– –	–	– –	–	–	1 –	– –	– –	–	–	–	–	–	–	–	W (Hy)	M6	
540	Macaria notata L. 1758	–	–	– 5	– 7	–	1 1	1	–	2 4	– –	– –	1	4	13	f–h	–	8	1	WL (Geb)	A5–E7, A8–M8	2. Generation nur partiell
541	Macaria alternaria HBN. [1809] 1796	–	3	5 6	9 24	1	23 14	20	12	11 14	1 –	3 5	10	34	84	f–n	–	6	1	WL (Geb/R)	A6–A8, A8–M8	2. Generation nur partiell, auch T: Birket n
542	Macaria signaria HBN. [1809] 1796	–	–	1 2	4 13	–	1 –	3	1	– 1	– –	– –	2	3	–	f–v*	–	4	–	WN (Geb)	A6–A8	* als R v
543	Macaria liturata CL. 1759	–	2	21 5	22 59	7	18 25	28	10	35 9	– –	3 2	1	–	–	h–sh	–	94	2	WN (Geb)	M5–E7, E7–M8	2. Generation m.o.w. partiell
544	Chiasmia clathrata L. 1758	1	–	1 –	1 3	25	20 12	5	38	24 12	1 1	11 8	1	1	2	f–v(4)	–	17	4	mGr (Geb, Agr)	A5–E6, A7–E8	auch T: WaM, WaN(w, o), HO, HM–Ruderal, HW Birket 1983 1 Ex
545	Itame wauaria L. 1758	1	–	2 1	19 40	–	1 –	–	1	– –	– –	– –	–	–	–	v–h	–	1	–	Geb*	E6–E7	*v.a. in Gärten
546	Itame fulvaria VILL. 1789	–	–	– –	– –	–	– –	1	–	– –	– –	– –	–	–	1	–	–	–	–	Geb/R (Hy)	E6–M7	1989 WaS und WaN je 1 Ex.
547	Theria rupicapraria SCHIFF. 1775	–*	–	– –	– –	–*	– 3	3	1	– –	– –	– –	–	–	–	f–n(4)	–*	–*	–*	Geb	E2–E3	♂♂, *F.F.w.r., im Garten nur 1983 + 1989
548	Erannis bajaria SCHIFF. 1775	–	–	– 3	1 2	–	– –	–	–	– –	– –	– –	–	–	–	v–n	–*	–	–	Geb (Xe)	M10–M11	♂♂, *F.F.w.r.
549	Erannis leucophaearia SCHIFF. 1775	–	2	2 –	1 –	–	– –	–	1	14 –	– –	2 –	2	–	–	1	–*	–*	–*	WL (Geb)	A3–A4	♂♂, *F.F.w.r., auch T: Berglwald n
550	Erannis aurantiaria HBN. [1799] 1796	–	–	– –	– –	–	– –	–	–	2 2	– –	– –	1	3	1	f–n	–*	–	–	WL (Geb)	M10–M11	♂♂, *F.F.w.r.

Nr.	Art	SIEDLUNG SiS	SiM	Garten SiN	WALD WaS	Wasserwerk WaM	WaN	WNw	WNo	HALBTROKKENRASEN HO	HM	HW	"DACH. MOOS" Au	We	Mb	VOR 1987 Gar	Mo	HO	HM	ÖKOLOGIE	FLUGZEIT	BEMERKUNGEN
551	Erannis marginaria F. 1777	1	1	26	22	3	1			4	–	–			–	h	–•	–•	–•	WL (Geb)	A3-M4••	♂♂, •F.F.w.r., ••1986 1 Ex E4
				4	16		–	2	1	3	–	–	3	1								
552	Erannis defoliaria CL. 1769	–	–	1	–	–	–			–	–	–			–	n-h	–•	–	–•	WL (Geb)	E10-E11	♂♂, •F.F.w.r
				7	14		2	–	–	3	–	2	9	16								
553	Phigalia pedaria F. 1787	–•	–	12	5	–•	–			11	–	4			–	v-h	–•	–•	–•	WL (Geb)	A1-A4	♂♂, •F.F.w.r
				5	1		–	3	1	1	–	1	3	–								
554	Apocheima hispidiaria SCHIFF. 1775	–•	–	–	–	–•	–			–	–	1			–	–	–•	–•	–•	WL (Geb)	E3	♂♂, •F.F.w.r
				–	–		–	–	–	–	–	–	–	–								
555	Lycia hirtaria CL. 1759	1	4	16	2	2	2			4	–	–			–	v-h	–•	–	–	WL (Geb)	A3-M5	•F.F.w.r Gen.prp
				7	3		2	2	3	3	–	–	1	–								
556	Biston strataria HUFN. 1767	–	2	–	–	–	–			–	1	1			–	f-v	–•	–	1	Geb (WL)	M3-E4	•F.F.w.r
				1	–		–	2	–	–	–	–	–	–								
557	Biston betularia L. 1758	1	–	2	2	–	6			9	2	12			15	v	–•	8	2	WL (Geb)	M5-E7	•Entw.graben 1983 8 Ex.
				4	3		19	5	–	8	–	12	3	4								
558	Peribatodes rhomboidaria SCHIFF. 1775	1	2	14	43	3	6			3	–	7			–	h	–	8	–	W (Geb)	A7-A9	
				31	374		25	9	16	22	–	5	3	–								
559	Peribatodes secundaria ESP. 1797	–	–	1	8	1	12			2	–	3			1	n-h	–	10	–	WN (Geb)	M7-E8	SiN + WaS öfters als R
				4	73		40	59	12	11	1	9	1	–								
560	Cleora cinctaria SCHIFF. 1775	–	–	–	–	–	1			1	–	–			–	–	–	1	1	mGr (Geb)	A5-M6	Mallertshofer Holz 1989 h, WaN 1989 2 ♂♂
				–	1		–	–	–	–	–	–	–	–								
561	Deileptenia ribeata CL. 1759	–	–	4	18	14	7			16	2	1			8	3•	–	11	–	W (Geb)	E6-M8••	•nur 1986, ••1987 bis E8
				3	128		13	43	17	21	1	–	21	8								
562	Alcis repandata L. 1758	7	1	16	119	15	41			29	–	3			9	h-sh	–	39	–	W (Geb)	A6-A8, M9-M10•	•3 Ex. 1988
				18	728		72	169	132	59	1	4	11	9								
563	Boarmia roboraria SCHIFF. 1775	–	–	–	2	–	–			4	–	–			21	1	–	7	–	WL	M6-E7	
				–	6		–	–	–	3	–	1	–	12								
564	Serraca punctinalis SCOP. 1763	–	1	4	15	1	2			31	1	4			15•	v-n	–	7	–	WL (Geb)	A5-M7, E7••	•Birket 1983 3 Ex, ••1988 1 frisches Ex
				6	39		8	3	10	26	–	8	56	21								
565	Ectropis bistortata GOEZE 1781	4	3	37	62	13	10			9	–	1			15	h-sh	–	8	2	Ub (W, Geb)	M3-E5•, E6-M8, M9-M10••	S-Bahnhof 1988 2 Ex., •z.T. bis M6, ••nur sehr partiell
				13	115		8	13	11	14	–	2	13	9								
566	Ectropis extersaria HBN. [1799] 1796	–	–	–	2	–	1			–	–	–			–	f-v	–	–	–	WL (Geb)	E5-A7	
				–	1		–	–	–	–	–	–	2	–								
567	Aethalura punctulata SCHIFF. 1775	–	–	–	–	1	2			–	–	–			8	3	–	1	–	WL (Hy, Geb)	M4-E6	
				–	–		1	–	2	1	–	–	–	5								
568	Ematurga atomaria L. 1758	(T)	–	–	–	(T)	5•			2	(T)	3			1•	–	–	1	(T)•	mGr (Xe, Geb)	A5-M8 (2 Generationen)	•T h-sh ("HM"→ Ruderal), am L. n. opt
				–	–		2•	1•	2•	3	1•	5	1•	–								
569	Bupalus piniaria L. 1758	–	–	7	3	2	8			14	–	2			–	n-h	–	26	–	WN (Geb)	A5-A7•	•1987 1 Ex. M7, Schw.holz 1988 1 Ex. T
				1	1		3	23	9	16	–	2	–	–								
570	Siona lineata SCOP. 1763	–	–	–	–	–	–			1	1•	11••			–	–	–	–	1	mGr	E5-A7	T: HM (Ruderal), HW, Ruderregattastrecke h am L. n. opt.
				–	–		–	–	–	1	5•	11	–	–								
Addenda:																						
268b	Photedes pygmina HAW. 1809	–	–	–	–	–	–			–	–	–			–	–	–	–	–	Hy	A8-A9	WaN 1989 2 ♂♂
				–	–		–	–	–	–	–	–	–	–								
498b	Eupithecia pimpinellata HBN.	–	–	–	–	–	–			–	–	–			–	–	–	–	–	Geb (Xe, mGr)	A8	1989 im Mallertshofer Holz 4 Ex
				–	–		–	–	–	–	–	–	–	–								

Artenzahlen:

Gesamt:

Tagfalter	58	Arten
Bombyces + Sphinges	96	Arten
Noctuidae	225	Arten
Geometridae	193	Arten
Summe	572	Arten

Jahr	SIEDLUNG SiS	SiM	Garten SiN	WALD WaS	Wasserwerk WaM	WaN	WNw	WNo	HALBTROKKENRASEN HO	HM	HW	"DACH. MOOS" Au	We	Mb	VOR 1987 Gar	Mo	HO	HM	Σ
1987	115	136	217	240	171	260			267	160	266			181					431
1988			222	304		277	253	283	261	132	260	183	184						445
															357	144	270	162	→ Σ 514

Die Artenzahlen spiegeln konstante, vom Jahr weitgehend unabhängige Muster wieder, wie dies aus dem Beispiel des Flughafengebiets (HO, HM, HW) schön zu ersehen ist. In gewissen Grenzen gilt das auch für die Individuenausbeuten, das Verhältnis HO/HM/HW zeigt beispielsweise recht konstante Werte von 3,3/1/2,9.

4.4. FAUNISTISCHE HINWEISE

Auf eine eingehende Erläuterung der faunistischen Besonderheiten, so interessant dies auch wäre, soll im Rahmen dieser Arbeit verzichtet werden. Da dies teilweise bereits an anderer Stelle geschah, sei hier nur auf HAUSMANN (1988) verwiesen.
Einige für die Thematik relevante Informationen aus der Faunistik werden jedoch im folgenden kurz aufgelistet. Es handelt sich hierbei um Arten, bei denen Arealerweiterungen festzustellen sind, solche mit Arealverlusten und schließlich Arten mit stark lokaler Verbreitung. Die Angaben beziehen sich auf Prozesse bzw. Befunde dieses Jahrhunderts in Südbayern.

Als Basis wird die von OSTHELDER (1925-1933) vor ca. 60 Jahren publizierte relativ vollständige Fauna Südbayerns und der angrenzenden nördlichen Kalkalpen verwendet. Die Hauptreferenz stellen die in der Folgezeit durch WOLFSBERGER (1945-1949; 1950; 1953/1954; 1954/1955; 1958; 1960; 1974 u.a.) veröffentlichten Ergänzungen dar.

4.4.1. Arealerweiterungen

Bei den Arealerweiterungen wie in den unten aufgeführten Fällen sind Ortsveränderungen von Schmetterlingen (♀♀) zu postulieren, die entweder in Vorstößen über viele Kilometer hinweg (mindestens 10-50) oder in einer mehr oder weniger stetigen Weise über mittlere Distanzen von 3-10 Kilometer erfolgten.
Derartige Ortsveränderungen entsprechen jedoch (meist) nicht dem "trivial movement" (sensu SOUTHWOOD, 1978) der betreffenden Art. Vielmehr kommt es oft im Zuge solcher Arealerweiterungen zu erfolgreichen Kolonisationen von geeigneten Habitaten, wo die Art dann vergleichsweise orts- und habitattreu bleibt.
Folgende Arten sind zu dieser Gruppe zu rechnen:

Bombyces und Sphinges: Gluphisia crenata

Noctuidae: Euxoa tritici, E. aquilina, Noctua janthina, N. comes, Apamea scolopacina, Hoplodrina ambigua, Eremodrina gilva, Calophasia lunula, Euthales algae, Bryoleuca raptricula

Geometridae: Lygris mellinata, Thera juniperata, Eupithecia intricata, Eupithecia millefoliata, Eupithecia sinuosaria

Die Liste erhebt keinen Anspruch auf Vollständigkeit, bespielsweise könnten auch *Agrotis venustula, Zanclognatha tarsipennalis* und *Eupithecia virgaureata* hierher gehören, u.U. wurden sie jedoch in vergangenen Zeiten auch nur übersehen bzw. verwechselt.
Wanderfalter, die neuerdings in Südbayern häufiger nachgewiesen werden, wie z.B. *Mythimna albipuncta* interessieren uns in bezug auf die Thematik hier weniger.

4.4.2. Arealverluste

Arealverluste sind schwieriger zu belegen als Arealgewinne.
Wenn man den Blick jedoch nicht auf so große Areale, wie dies Südbayern ist, richtet,

sondern Arealverluste auf lokalerem Niveau untersucht, werden sich - vor allem korreliert mit Zerstörungen von Lebensräumen - viele Beispiele finden lassen.

In einer vorbereitenden Arbeit konnte in diesem Sinne bei den hygrophilen Arten der Noctuiden-Unterfamilie *Amphipyrinae* ein überdurchschnittlicher Rückgang in den Arten- und Individuenzahlen belegt werden. So sind beispielsweise die auf Schilf angewiesenen Eulen *Rhizedra lutosa* und *Mythimna pudorina* im Untersuchungsgebiet nur vereinzelt zu finden, während sie vor 60 Jahren von OSTHELDER (1925-1933) aus Schleißheim noch als "sehr häufig" gemeldet wurden. Andere "Röhricht-Eulen" wie *Mythimna straminea* TR., *Leucania obsoleta* HBN., *Archanara geminipuncta* HAW. und *Archanara algae* ESP. sind im Verlauf der letzten 100 Jahre aus dem Gebiet Oberschleißheim wohl ganz verschwunden. Diese Befunde sind mit hoher Wahrscheinlichkeit auf die Zerstörung der Niedermoorflächen im Dachauer Moos zurückzuführen.
Eine parallele Entwicklung bei den Tagfaltern, nämlich die Extinktion von Populationen vieler hygrophiler Arten v.a. im Dachauer Moos wurde in HAUSMANN (1988) belegt.

4.4.3. Arten mit lokalem Vorkommen

Das Verbreitungsmuster lokal verbreiteter Arten kann im Zusammenhang mit Spezialisierungen auf bestimmte Raupenfutterpflanzen wertvolle Informationen zur Beurteilung von Verbreitungsstrategien liefern.
Auch die folgende Liste ist sicher nicht vollständig, sie spiegelt einige aus den Publikationen OSTHELDERs (l.c.) und WOLFSBERGERs (l.c.) entnommene Verhältnisse wieder, die für Südbayern bzw. im besonderen für die untere Hochebene des Faunengebietes zutreffen. Eine Reihe von Zusatzinformationen stammt auch aus Gesprächen mit verschiedenen Wissenschaftlern.

Bombyces und Sphinges: Dasychira selenitica, Eilema lutarella, Pelosia muscerda, Hybocampa milhauseri, Lophopteryx cuculla, Heterogenea asella, Tethea ocularis, Tethea fluctuosa, Cilix glaucata, Cosmotriche lunigera, Bacotia sepium, Narycia monilifera

Noctuidae: Euxoa obelisca, Eugnorisma depuncta, Rhyacia lucipeta, Rhyacia simulans*, Sideridis albicolon, Eriopygodes imbecilla* (Glazialrelikt), *Cerapteryx graminis, Orthosia populi, Mythimna pudorina, Amphipyra berbera*, Talpophila matura, Ipimorpha subtusa, Cosmia affinis, Apamea lateritia, Apamea unanimis, Photedes extrema, P. fluxa* (vielleicht ein Arealerweiterer), *Amphipoea lucens, Nonagria typhae, Nonagria nexa, Atypha pulmonaris, Cucullia lucifuga, Parastichtis suspecta, Cirrhia aurago, Cirrhia gilvago, Cirrhia ocellaris, Hyboma strigosa* (Arealerweiterer?), *Chrysaspidia putnami, Chrysoptera c-aureum, Parascotia fuliginaria, Colobochyla salicalis, Zanclognatha tarsipennalis, Trisateles emortualis*

Geometridae: Comibaena pustulata, Hemithea aestivaria, Hemistola chrysoprasaria, Sterrha muricata, Sterrha inquinata, Sterrha dimidiata, Sterrha emarginata, Scopula rubiginata, Anaitis praeformata, Acasis viretata, Lygris testata, Thera firmata, Xanthorhoe designata, Calostigia olivata, Euphyia molluginata, Perizoma bifaciata, Perizoma flavofasciata, Anticlea badiata, Pelurga comitata, Hydrelia testaceata, Asthena anseraria, Eupithecia inturbata, Eupithecia valerianata, Eupithecia venosata, Eupithecia egenaria, Eupithecia extraversaria, Eupithecia selinata, Eupithecia abbreviata, Eupithecia dodoneata (**neu für Südbayern!** HAUSMANN in Vorber.), *Eupithecia lariciata, Calliclystis chloerata, Arichanna melanaria, Abraxas grossulariata, Ellopia fasciaria,*





Abb. 3c und 3d: Sterrha muricata (oben) und Abraxas grossulariata (unten), zwei in Südbayern nur lokal verbreitete Spanner (Geometridae).

Deuteronomos alniaria, Lozogramma chlorosata, Itame fulvaria, Theria rupicapraria, Erannis bajaria, Erannis leucophaearia, Apocheima hispidaria, Boarmia roboraria, Ectropis extersaria

Interessant sind auch die extremen Häufigkeiten von sonst weniger beobachteten Arten wie *Scotia clavis, Amathes sexstrigata, Peribatodes rhomboidaria* und einiger anderer. Die mit * gekennzeichneten Arten sind als wanderverdächtige Arten wie *Chloridea peltigera* oder *Nycterosea obstipata* in bezug auf die Thematik dieser Arbeit natürlich differenziert zu betrachten. Es handelt sich hierbei wohl nicht um stabile lokale Populationen.

5. DAS PHÄNOMEN TURNOVER

5.1. ARTEN-ZEIT-BEZIEHUNG

Jedem, der sich faunistisch mit der Erstellung von Nachtfalter-Artenspektren befaßt, begegnet schon bald eine Reihe von Gesetzmäßigkeiten, wie z.B. das Phänomen, daß man im ersten Erhebungsjahr bei einer "punktuellen" Erfassung von Imagines auch unter größten Anstrengungen (Licht-, Köder-, Pheromonfang u.s.w.) nie ein vollständiges Artenspektrum eines definierten Standortes erhält. Es werden in den Folgejahren immer weitere Arten hinzukommen.

So erwähnt URBAHN (1973) neben langfristig beobachteten Häufigkeitsfluktuationen auch das Phänomen, daß manche Arten in Zeiträumen von einigen Jahren oder gar Jahrzehnten tatsächlich verschwinden. Sie werden "gewissermaßen ersetzt durch Neuankömmlinge. Dies alles ist bekannt und immer so gewesen ..." (URBAHN, l.c.).

Wenn man sich als Beispiel einmal die im Garten (SiN) in den letzten 5 Erhebungsjahren nachgewiesenen Eulenfalter (*Noctuidae*) betrachtet, ergibt sich folgendes Bild (der Kurvenverlauf wurde durch die Mittelwerte gelegt):

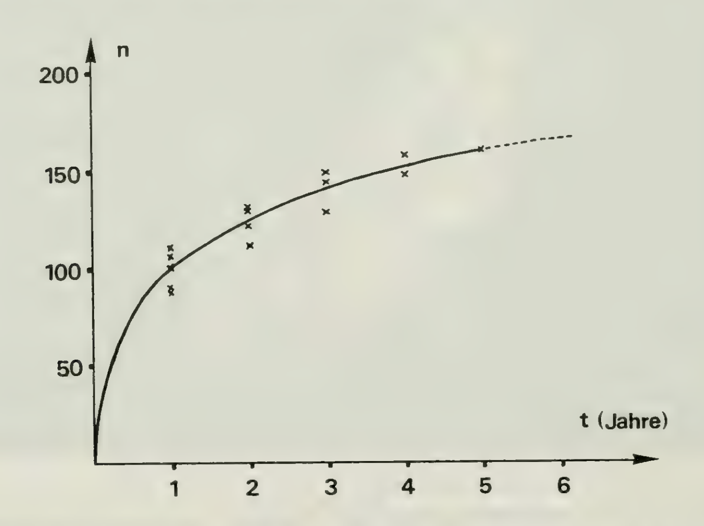


Abb 4: Zunahme der Artenzahl (n) der Familie Noctuidae im Lauf der letzten 5 Erhebungsjahre im Garten des Verfassers (SiN).
Increase of species number (n) in the family Noctuidae during the last 5 trapping-years in the garden of the author.

Der Kurvenverlauf zeigt eine Annäherung an eine Gesamt-Artenzahl von 170 Arten. Nimmt man diesen Wert mit 100 % an, so ergibt sich im 1. Jahr ein Prozentsatz von 58,5 %, im 2. Jahr 72,6 %, im 3. Jahr 82,2 %, im 4. Jahr 89,4 % und im 5. Jahr 93,5 %. Das bedeutet, daß bei derartigen punktuellen Methodiken Erfassungsintervalle von mindestens 4 Jahren erforderlich sind, um ein einigermaßen "komplettes" Artenspektrum zu erhalten.
In einem durchschnittlichen ersten Jahr fehlen also ca. 70 Arten. Es bleibt jedoch unklar, ob es sich um eine tatsächliche Abwesenheit handelt, bzw. wie hoch der Prozentsatz der Arten ist, die lediglich nicht erfaßt wurden.
Bei einer flächendeckenderen Methodik ergeben sich vollständigere Werte für das erste Jahr und eine schnellere Annäherung an die maximale Artenzahl (siehe 6.3.1.).

Zur Abschätzung der Fehlerquellen ist zu berücksichtigen, daß sich die Abbildung 4 ausschließlich auf die durchgeführten Lichtfallenfänge stützt. Eine Reihe von Arten (ca. 10), die ein offensichtlich nicht optimales Anflugverhalten ans Licht zeigen, wurde daher ausgeklammert.
Inwieweit einige weitere Arten auf diese Weise methodisch bedingte "Zuwachsvorgänge" vorgetäuscht haben könnten, muß an dieser Stelle ebenso offenbleiben wie die Frage, wie groß der Anteil der Arten ist, die durch ihre Seltenheit in der vorliegenden Methodik unter der "Erfassungsschwelle" geblieben sind. Da es sich bei Lichtfallenfängen um eine Probeentnahme handelt, können sehr seltene Arten in einer Stichprobe auftauchen, in einer anderen jedoch fehlen und so zu einer Unterschätzung der Artenzahlen in den ersten Erhebungsjahren führen. Weitere Aufschlüsse werden uns hierzu die Häufigkeitsverteilungen (Kapitel 7) geben.
Fehlerquellen sind also theoretisch alle Faktoren, die Arten unerkannt lassen, die im Einzugsbereich der Lichtfalle anwesend sind, wie z.B. auch die Witterung, der Fangrhythmus, Bestimmungsprobleme (siehe 3.3.), Fallenbeschaffenheit, Lichtqualität u.s.w..

Prognosen, die mittels Arten-Zeit-Beziehungen getroffen werden, können jedoch zu guten Ergebnissen führen: Die in HAUSMANN (1988) abgebildete Kurve postulierte für das Jahr 1988 einen Artenzuwachs von 30 Arten, real waren es dann 28 neue Nachweise.

Bei der Betrachtung der Arten-Zeit-Kurven (z.B. Abb. 4) werden Artenumsätze von Jahr zu Jahr ersichtlich: Im zweiten Jahr kommen im Garten, verglichen mit dem Ausgangsjahr, durchschnittlich 24 Noctuiden-Arten hinzu. Bei gleichbleibender Artensumme bedeutet das auch 24 fehlende Arten. Diesen Artenaustausch bezeichnet man als "Turnover".

5.2. FORMELN

Die dynamischen Prozesse, die sich auf der Ebene der Artenspektren abspielen, finden erst seit der richtungsweisenden Publikation MAC ARTHUR & WILSONs (1967) in verstärktem Maße Beachtung. Jene hatten anhand von kleinen Inseln sehr anschaulich gezeigt, daß sich der Artenbestand in einem dynamischen Gleichgewicht befindet, das von der Größe der Insel ("Auffangtrichter" für Immigranten) und den Barrieren gegen die Verbreitung (Abstand zum Festland) abhängig ist. Dieses Modell ist in gewissen Grenzen auch für "Habitat-Inseln auf dem Festland, z.B. ... einem zurückgebliebenen

Sumpf" anwendbar (MAC ARTHUR & WILSON, l.c.). Man könnte also auch im Untersuchungsgebiet die Artenspektren relativ isolierter Standorte, wie beispielsweise das Wasserwerk oder die verbliebenen Moorbirkenwäldchen (Birket, Torfeinfang, Franzosenhölzl) als in einem Gleichgewicht befindlich betrachten, das von einem ständigen Artenaustausch geprägt ist (Immigration und Extinktion von Populationen). An weniger verinselten Lebensräumen finden vermutlich auf lokalem Niveau ähnliche Prozesse statt, die sich jedoch schneller wieder ausgleichen können.

Zur Berechnung der Arten-Austauschraten (Turnover, "T_a") von Jahr zu Jahr verwendet man zweckmäßigerweise die Formel für den absoluten Turnover, dem prozentualen Anteil der ausgetauschten Arten am Ausgangsartenspektrum:

$$T_a = \frac{(X_1 + X_2)\ 100}{S_1}\ \%$$

S_1 = Ausgangsartenzahl
X_1 = Zahl der neu hinzugekommenen Arten
X_2 = Zahl der fehlenden Arten

Wenn beispielsweise im Garten (SiN) 1987 90 Noctuidenarten, 1988 dagegen 89 festgestellt wurden, so spiegelt die Stabilität der Arten**zahl** keineswegs stabile Verhältnisse in der Arten**zusammensetzung** wieder: 21 Arten kamen hinzu, 22 konnten nicht mehr nachgewiesen werden. In die o.g. Formel eingesetzt ergibt sich folgender Artenumsatz:

$$T_a = \frac{(21 + 22)\ 100}{90}\ \% = 47{,}8\ \%$$

Für unser eingangs erwähntes Beispiel der Austauschrate von Jahr 1 nach Jahr 2 in der Arten-Zeit-Beziehung (Abb. 4) errechnet sich ein Turnover von 48,3 %.

Nach DIAMOND (1969) ist die Höhe des Turnovers von der Länge des "Census Intervalls" zwischen zwei Aufnahmen abhängig. Zur Berechnung des Relativen Turnovers (T_r) dient folgende Formel:

$$T_r = \frac{(I + E)\ 100}{t\ (S_1 + S_2)}$$

I = Zahl der hinzukommenden Arten
E = Zahl der fehlenden Arten
S_1 = Gesamtartenzahl (1. Aufnahme)
S_2 = Gesamtartenzahl (2. Aufnahme)
t = Zeitspanne (Jahre) zwischen S_1 und S_2 (Census Intervall)

Bei längeren Zeitspannen kommt in zunehmendem Maße ein "in-and-out-effect" (das Wiederauftauchen ausgelöschter Populationen und umgekehrt) zum Tragen, wodurch die Summe der Austauschereignisse unterschätzt wird (DIAMOND & MAY, 1976).
In den folgenden Berechnungen wird unter "Turnover" stets der absolute Turnover verstanden.
Es erscheint wichtig, den "Pseudoturnover" (NILSSON & NILSSON, 1983), verursacht durch Stichprobenfehler (siehe 5.1.) vom tatsächlichen Austauschgeschehen abzutrennen.

Bei punktbezogenen Erhebungen sind nun einige verschiedene Reaktionsmuster der Arten denkbar: Bei mobilen, mehr oder weniger ubiquitären Arten hängt das Ausmaß von

verursachten Turnoverereignissen von der Abundanz ab, häufige Arten (z.B. die häufigsten Wanderfalter) werden stets nachgewiesen, seltene Arten verurachen Turnover; hier wäre als Beispiel der Wanderfalter *Nycterosea obstipata* zu nennen.
Bei relativ ortstreuen Arten kommt es nun neben dem Ausmaß der Dispersionsaktivität auf die Entfernung zum typischen Habitat an: Wird die Art im typischen Lebensraum erfaßt, kommt es zu wenigen Turnoverereignissen, ist das Habitat sehr weit entfernt, wird ein Zuflug selten erfolgen. Auch hier ist - in langen Zeiträumen betrachtet - der Turnover vergleichsweise klein. Bei "mittleren" Entfernungen kommt es dagegen in einer starken Weise zu einem Wechsel von Auftauchen und Verschwinden. Eine Ermittlung solcher Distanzen kann für Fragen bezüglich der Vernetzungen von Biotopen von Interesse sein.

6. INTERPRETATION DES APPARENTEN TURNOVERS

6.1. BERECHNUNG DER AUSTAUSCHRATEN

6.1.1. Vorbemerkungen

Um den Turnover über mehrere Jahre hinweg auf die Konstanz des Wertes hin zu testen, werden in einem ersten Schritt die Austauschvorgänge im Garten des Verfassers (SiN) etwas genauer beleuchtet. Für die Tests der Standortabhängigkeit und der Abhängigkeit von verschiedenen Artengruppen (nach Kriterien der Systematik, der Jahreszeiten u.s.w.) scheinen sich v.a. die Werte, die sich aus den Fängen der letzten 3 Jahre errechnen, durch die konstant gehaltene Methode zu eignen.
Für die Berechnungen wird die Formel für den absoluten Turnover verwendet.
Einige Arten mußten wegen ihres nicht optimalen Anflugverhaltens ausgeklammert werden.

6.1.2 Liste der Turnover-Werte

6.1.2.1. Garten (SiN; Tab. 4):

In den 5 Erhebungsjahren wurde mit einigermaßen vergleichbarer Methode Lichtfang betrieben: Standort und Bau der Falle waren praktisch konstant, die Anzahl der Fangnächte in der Hauptflugzeit (10.6.-31.8.) betrug 25, 39, 38, 30 bzw. 35. Mit einer Ausnahme (1985) wurde stets über 100mal pro Jahr gefangen.
Eine Verfälschung der Austauschraten 1983 → 1985 findet durch die Addition zweier Jahresturnover und durch den "in-and-out-effect" statt: Es handelt sich um zwei gegenläufige Komponenten, die sich vielleicht mehr oder weniger egalisieren (vergleiche DIAMOND & MAY, 1976).

"BOMBYCES UND SPHINGES" (ohne *Zygaenidae, Sesiidae, Psychidae* und einige nicht optimal erfaßbare Arten, z.B. *Macroglossum stellatarum*)

	für TO verwendete Arten Σ *species-Σ, used for turnover*	Immigrationsereignisse	Extinktionsereignisse	Turnover	Arten Σ addiert *accumulated species-Σ*
nur vor 1983	1	-	-	-	(1)
1983	33	-	-	-	33
1985	24	6	15	63,6 %	39
1986	29	12	7	79,2 %	47
1987	30	9	8	58,6 %	49
1988	27	6	9	50,0 %	51
				62,8 %	

NOCTUIDAE (ohne einige nicht optimal erfaßbare Arten, z. B. *Ectypa glyphica*)

	für TO verwendete Arten Σ	Immigrationsereignisse	Extinktionsereignisse	Turnover	Arten Σ addiert
nur vor 1983	1	-	-	-	(1)
1983	111	-	-	-	111
1985	104	19	26	40,5 %	130
1986	100	27	31	55,8 %	148
1987	90	22	32	54,0 %	157
1988	89	21	22	47,8 %	159
				49,5 %	

GEOMETRIDAE (ohne einige nicht optimal erfaßbare Arten, z.B. *Ematurga atomaria*)

	für TO verwendete Arten Σ	Immigrationsereignisse	Extinktionsereignisse	Turnover	Arten Σ addiert
nur vor 1983	2	-	-	-	(2)
1983	97	-	-	-	97
1985	56*	5*	46*	52,6* %	102*
1986	100	52*	8*	107,1* %	129
1987	93	20	27	47,0 %	141
1988	102	23	14	39,8 %	146
				((61,6 %))*	

Die mit * gennzeichneten Werte sind verfälscht, da bei den Geometriden 1985 die Artbestimmung nicht in allen Fällen mit der nötigen Genauigkeit durchgeführt wurde.

Der vom Jahr 1983 auf das Jahr 1986 berechnete Turnover beträgt 56,7 %, eine Verfälschung dieses Austausches durch das Mehrjahresintervall und durch stattfindenden in-and-out-effect ist zu veranschlagen.
Der durchschnittliche Geometriden-Turnover im Garten würde dann 47,8 % (Mittel aus drei Werten) betragen.

MACROHETEROCERA Σ

	für TO verwendete Arten Σ	Immigrationsereignisse	Extinktionsereignisse	Turnover	Arten Σ addiert
nur vor 1983	4	-	-	-	(4)
1983	241	-	-	-	241
1985	183*	27*	86*	47,1* %	271
1986	229	89*	45*	73,2* %	324
1987	213	51	67	51,5 %	347
1988	218	50	45	44,6 % ((54,1 %))*	356**

* Siehe Bemerkungen zur Familie *Geometridae*! Ein besserer Durchschnittswert errechnet sich wohl aus den beiden letzten Werten mit 48 %.
** Die bisher im Garten (vorne) festgestellte Gesamtartensumme unter Einschluß der Arten, die für die Turnoverberechnungen nicht berücksichtigt wurden, beträgt 366. Nimmt man auch die 30 m entfernt an WaS sowie die bis Juni 1989 neu festgestellten Arten hinzu, so kommt man auf 414 Arten.

6.1.2.2. Zusammenstellung der in den letzten 3 Jahren festgestellten Turnoverwerte (Tab. 5)

"BOMBYCES UND SPHINGES"

	SiN	WaN	HO	HM	HW	Mittel
1986/87	58,6 %	-	29,8 %	38,7 %	-	45,3 %
1987/88	50,0 %	38,6 %	45,5 %	70,4 %	31,1 %	
Mittel	54,3 %	38,6 %	37,6 %	54,6 %	31,1 %	

NOCTUIDAE

	SiN	WaN	HO	HM	HW	Mittel
1986/87	54,0 %	-	35,3 %	61,0 %	-	46,0 %
1987/88	47,8 %	33,9 %	40,7 %	50,0 %	45,3 %	
Mittel	50,9 %	33,9 %	38,0 %	55,5 %	45,3 %	

GEOMETRIDAE

	SiN	WaN	HO	HM	HW	Mittel
1986/8	47,0 %	-	48,4 %	102,6 %	-	} 57,8 %
1987/88	39,8 %	47,3 %	42,0 %	88,2 %	47,1 %	
Mittel	43,4 %	47,3 %	45,2 %	95,4 %	47,1 %	

MACROHETEROCERA Σ

	SiN	WaN	HO	HM	HW	Mittel
1986/87	51,5 %	-	39,1 %	66,9 %	-	} 48,8 %
1987/88	44,6 %	39,8 %	42,0 %	62,9 %	43,4 %	
Mittel	48,1 %	39,8 %	40,6 %	64,9 %	43, 4 %	

6.1.3. Folgerungen

- Der Turnover scheint an einem definierten Standort *von Jahr zu Jahr* konstant zu bleiben, deutlichere Schwankungen wurden bisher nur bei den Bombyces und Sphinges beobachtet (z.B. HO und HM), was aber vermutlich an der größeren Störanfälligkeit aufgrund der geringen Stichprobengröße liegt.
  Wie groß der Einfluß des Witterungsverlaufs eines Jahres auf den Turnover ist, läßt sich anhand des Materials noch nicht abschätzen, da im Zeitraum der Untersuchungen keine genügend krassen Unterschiede auftraten.

- Das Ausmaß der Artenaustauschprozesse ist stark vom jeweiligen *Standort* (Biotopbeschaffenheit) abhängig:
  Der hohe Turnover im Offenland (HM) erklärt sich durch das vergleichsweise starke Auftreten von Gastarten aus mehr oder weniger entfernten Habitaten (siehe 6.2.). Am reich strukturierten Waldrand (HO) liegen zwei unterschiedliche Lebensraumtypen in unmittelbarer Nähe des Fallenstandortes. Zufliegende Nachtfalterarten spielen hier eine geringere Rolle, der Turnover ist daher niedriger.
  Der im Siedlungsgebiet (SiN) relativ große Artenaustausch deutet vermutlich eine Abhängigkeit des Turnovers vom Sukzessionsstadium bzw. dem Ausmaß der Störungen und Eingriffe in das Ökosystem durch den Menschen an. SPITZER & LEPS (1988) wiesen eine Korrelation von Sukzessionsstadium des Lebensraumes und der Höhe der Abundanz-Schwankungen (Fluktuation) der Arten nach. Inwieweit nun Turnover im Artenspektrum und Fluktuationen in den Häufigkeiten der Arten miteinander verknüpft sind, wird in einem folgenden Kapitel getestet (6.4.).
  Die Frage, ob es sich nicht nur um eine Abhängigkeit von der Stichprobengröße handelt (diese war an den Standorten HM und SiN am kleinsten), bleibt primär jedoch offen und wird gesondert untersucht (z.B. Kapitel 7).

- Der Turnover ist abhängig von der gerade betrachteten *Artengruppe*. Besonders deutlich wird dies bei den Geometriden an HM, bei denen die ausgetauschten Arten bisweilen das Ausgangsartenspektrum an Zahl übertreffen. Da diese Familie vorwiegend aus Bewohnern der Wälder und deren Ränder besteht, zeigt sich, daß die Abhängigkeit

von der Artengruppe im Grunde eine Abhängigkeit vom Ökotyp der betrachteten Arten und den jeweiligen Distanzen und Flächengrößen der benachbarten geeigneten Lebensräume ist.
Der Gesamtturnover für die Spanner (*Geometridae*) fällt wegen des Offenlandwerts (HM) relativ hoch aus. In manchen Habitaten, z.B. im Garten (SiN) liegt er jedoch niedriger als der Artenumsatz bei den Noctuiden.
Die Geometriden-Unterfamilie *Boarmiinae* fällt an Waldrand-Standorten mit einem niedrigen Turnover von 36,9 % (HO, Mittelwert aus zwei Jahren) bzw. 37,1 % (WaN) aus dem Rahmen. Im Garten lag er sogar noch darunter (siehe 6.4.3.). Im österreichischen Gitschtal (aus WIESER, 1987) war Ähnliches festzustellen, hier war der Effekt bei 44,0 % für die Geometriden und 23,4 % für die Boarmiinen noch stärker.
Bemerkenswert ist auch das gleichmäßige Niveau der Geometriden-Austauschraten an allen Standorten, wenn man das Offenland (HM) außer Acht läßt: Es ergibt sich ein Wert von 45,3 % bei einem Variationskoeffizienten von nur 7,7 %.

- Die *Größenordnung* des Turnover liegt in den meisten Biotopen zwischen 35 und 55 Prozent/Jahr, die Ergebnisse sind bei definierter Methodik reproduzierbar. Der Artenaustausch von durchschnittlich 36,7 %, der sich aus den Zahlenkolonnen WIESERs (l.c.) errechnet, liegt in diesem Rahmen und ähnelt stark den im Wasserwerk (WaN) festgestellten Verhältnissen.

6.2. TURNOVER DURCH KOLONISATIONSVERSUCHE BIOTOPFREMDER ARTEN

Eine indirekte Methode, Artenspektren ökologisch zu gewichten, ist die Ermittlung des "Spanneranteils". In dieser Familie ist der Anteil an Wald- und Waldrandbewohnern zwar deutlich höher, als z.B. bei den Eulenfaltern (*Noctuidae*), doch geben so ermittelte Werte nur einen sehr unvollständigen ersten Anhaltspunkt über die Präsenz dieses Ökotyps.
An den Fangstellen ergibt sich folgendes Bild (Angaben in %):

Tab. 6: Spanneranteile (%) an den verschiedenen Standorten 1987 und 1988.
Percentages of the Geometridae at the various trapping-sites 1987 and 1988.

	SIEDLUNG				WALD				HALBTROKKENRASEN			"DACH. MOOS"		
			Garten		Wasserwerk									
	SiS	SiM	SiN	WaS	WaM	WaN	WNw	WNo	HO	HM	HW	Au	We	Mb
1987	41	31	43	45	40	36			38	23	34			41
1988			46	43		39	42	39	40	22	34	46	42	

Im Offenland (HM), aber auch an Randbiotopen mit leichtem Offenlandcharakter (SiM, HW) ist der Spanneranteil niedriger. Sogar die etwas polarisierten Wasserwerks-Werte sind mit der Lage der Standorte korreliert, da WNw dem Waldrand am nächsten liegt.

Genauere Informationen ergeben sich allerdings, wenn die Beurteilung auf der Basis der in der Artenliste (4.3.) angegebenen ökologischen Charakteristik der Arten erfolgt. Wertet man die Haupt-Ökotypen des Gesamtartenspektrums aus, so kommt man zu folgender Zusammenstellung:

Tab. 7: Anteile der verschiedenen Ökotypen am Gesamtartenspektrum (*Macroheterocera*) im Untersuchungsgebiet.
Ecotype-percentages of the species spectrum (Macroheterocera).

Ub: 50	Arten	(9,8 %)		Geb: 174	Arten	(34,3 %)
mGr: 80	Arten	(15,8 %)		W: 120	Arten	(23,6 %)
Agr: 17	Arten	(3,3 %)		Hy: 44	Arten	(8,7 %)
Xe: 23	Arten	(4,5 %)				

Im *Offenland* (HM) zeigen sich bei einer derartigen Einteilung erwartungsgemäß deutlich erhöhte Werte bei den Ubiquisten (20,4 %) und den mesophilen Arten des Graslandes (23,1 %), leicht erhöht sind sie bei den Arten des Ackerlandes (5,4 %) und den Xerothermophilen (5,0 %), während die Arten der Wälder, der Waldränder, der Gebüschformationen und Hecken deutlich unter den Gesamtwerten liegen (Geb: 24,9 %; W: 17,2 %).
Man könnte also (verallgemeinernd) von ca. 46 % "biotopfremden" Arten sprechen, wenn man einmal alle Offenlandarten ohne die hygrophile Fauna als biotoptypisch bezeichnet.
Eine verfeinerte Methode der Betrachtung wird zeigen, daß der Prozentsatz der "Überfremdung" dieses Standortes noch höher ist: Hierzu wurde unter Berücksichtigung der Raupenfutterpflanzen getestet, welche Arten mindestens aus dem 150-300 m entfernten Ruderalgelände (siehe 2.2 und 9.2.) und welche mindestens vom Flughafenrand (800-1000 m) herbeigeflogen sein müssen.
Vom Ruderal stammen - so beurteilt - 88 Arten (39,8 %) und vom Flughafenrand 36 Arten (16,3 %). Bei diesem Anteil der Gastarten von 56 % handelt es sich wie gesagt um Mindestangaben!

Tab. 8 zeigt, daß solche biotopfremde Arten verstärkt am Turnovergeschehen beteiligt sind, daß also der apparente Turnover, der in den mit der vorliegenden Methodik erarbeiteten Artenspektren zu beobachten ist, durchaus mit tatsächlich in der Natur stattfindenden Prozessen verknüpft und keineswegs nur ein methodischer Artefakt ist.

Tab. 8: Artenzahlen und Turnover bei bodenständigen und zugeflogenen Arten im Offenland (HM) 1986-1988.
Species number and turnover of within habitat propagating and the visiting species in the study areas of open habitats.

Status	Arten-Σ 1986-1988 *species number*	Turnoverereignisse pro Art und Jahr *events of turnover per species and year*
potentiell bodenständig *species potentially propagating in site*	97	0,29
mindestens aus 150-300 m *at least from 150-300 m distances*	88	0,57
mindestens aus 800-1000 m *at least from 800-1000 m distances*	36	0,54

Wenn man eine grobe Abschätzung des Ausmaßes von Kolonisationsversuchen ins Offenland hinein wagt, kann man von ca. 150 Wald-, Waldrand- bzw. Gebüscharten ausgehen, die an den Rändern des Flughafengebiets vorkommen dürften, aber im Ruderal, wo Weiden die einzigen Bäume darstellen, keine Lebensgrundlage haben. Für ca. 1/4 dieser Arten konnte also im 3-Jahres-Zeitraum die Bewältigung der Distanz von ca. 1 km nachgewiesen werden. Da sich darunter vergleichsweise wenige ♀♀ befanden, wäre ein hypothetisches, an dieser Stelle neugeschaffener Biotop in dieser Zeitspanne nur von recht wenigen Arten dieser Gruppe besiedelt worden. Möglicherweise könnten jedoch von den Futterpflanzen ausgehende Geruchsstoffe ♀♀ bevorzugt anlocken.
Es zeichnet sich aber ab, daß man bei einer Anlage von solch isoliert liegenden Biotopen (z.B. auch im Ackerland) mindestens 10 Jahre, wenn nicht länger, warten muß, um auf natürlichem Wege zu einem einigermaßen biotoptypischen Artenspektrum zu gelangen. Ähnlich langsame Besiedelungsprozesse vermutet HEYDEMANN (1980) für die Arten der Feuchtbiotope. Erfolgskontrollen nach 1-5 Jahren, wie sie oft praktiziert werden, sollten in solchen Fällen daher differenziert betrachtet werden.

Im Ruderal kann man den Artenbestand, beurteilt nach Fläche und Reichhaltigkeit der Vegetation (Krautschicht sehr artenreich, wenige Gebüsch- und Baumarten) auf ca. 250-350 Arten schätzen. Abzüglich der auch an HM möglicherweise bodenständigen Arten ergeben sich 150-250 Arten, von denen in 150-300 m Entfernung ca. 1/3 bis die Hälfte in der Zeitspanne von 3 Jahren beobachtet werden konnte. Zu berücksichtigen ist hier die im Vergleich zu den umliegenden Wäldern geringere Ausgangsfläche (nur ca. 5 ha).

An den *anderen Standorten* ist eine derartige Beurteilung schwieriger, es können nur Einzelinformationen gegeben werden, wie im Fall der im Garten nachgewiesenen Nachtfalter, die durch die Larvalökologie an Pflanzen der Gattungen *Salix, Populus* und *Alnus* gebunden sind. Keine dieser Pflanzen kommt in einem Radius von 200-300 m um den Fangplatz herum vor.
In 5 Erhebungsjahren (siehe 6.1.2.1. und 9.2.) traten 17 so spezialisierte Arten auf, die durchschnittlich 0,51 Turnoverereignisse pro Art und Jahr verursachten. Auch zwei weitere außerhalb dieses Intervalls gefangenen und auf Weiden spezialisierte Arten wurden nur in einem Jahr (2 Austauschereignisse) beobachtet.
Für den Rest des Artenspektrums (339 Arten) errechnen sich 0,31 Turnoverereignisse pro Art und Jahr. Diese Ergebnisse ähneln den an HM (Ruderal) gemachten Beobachtungen stark.

6.3. ABHÄNGIGKEIT DES TURNOVERS VOM FLÄCHENINHALT DES ABGEDECKTEN AREALS

6.3.1. Vergleich der Werte

Tab. 9: Vergleich der Austauschraten in der Gesamtfläche mit denen eines Einzelstandortes.
Comparison of turnover-rates in the total area with those of a single trap.

Jahr *year*	GESAMTFLÄCHE Standorte *TOTAL AREA localities*	für Turnover verwendete Arten-Σ *species-Σ, used for turnover*	Turnover	GARTEN (SiN) Turnover *GARDEN*
1986	4	351	-	-
1987	10	416	24,8 %	51,5 %
1988	10	428	15,4 %	44,6 %

Eine Unschärfe dieses Vergleichs ergibt sich aus zwei Gründen: Erstens wurde durch das Fallennetz nicht eine einheitliche Fläche abgedeckt, es war von Jahr zu Jahr ein Ausweichen von Populationen in nicht fangabgedeckte, zwischen den Fallen liegende Biotope möglich.
Zweitens sind einige "Austauschereignisse" auf der Gesamtfläche auf den Wechsel von Standorten und die damit verbundene Veränderung der Biotopbeschaffenheit zurückzuführen. Daher sind vor allem die Jahre 1986/1987 wenig vergleichbar.

Nach einer Bereinigung dieser Unsicherheitsfaktoren würde der Gesamtflächen-Turnover noch niedriger liegen, vermutlich bei 5-10 %!

Bei einer größeren Flächenabdeckung durch mehrere Fallen verringert sich also der Turnover in einer drastischen Weise. Es findet eine Art Abpufferung des sich meist lokal abwickelnden Artenumsatzes statt.

6.3.2. Rückschlüsse für faunistische Ansätze

Aus dem genannten Phänomen leitet sich ein erhöhter Wirkungsgrad der Methode ab: Anstelle der normalerweise bei einer punktuellen Nachtfaltererhebung pro Jahr nachzuweisenden 50-65 % des Artenspektrums (siehe Arten-Zeit-Kurve, 5.1.) wurden 1987 und 1988 jeweils ca. 440 von 550 im Gebiet zu erwartenden Nachtfalterarten beobachtet (siehe HAUSMANN 1988). Das bedeutet im ersten Jahr einen Anteil von 80 %, im Zweijahresintervall 1987/1988 (473 Arten) sogar 86 %.

6.4. TURNOVER, KONSTANZ UND FLUKTUATION

6.4.1. Tagfalter (Unterer Inn: REICHHOLF, 1986)

Die Auswertung von umfangreichem Tagfalter-Material aus 10jährigen Linientaxierungen am unteren Inn ergab den interessanten Befund, daß bei recht stabilen Artenzahlen pro Jahr ein "außerordentlich hoher Artenumsatz ..., der im Mittel 36 % beträgt" (REICHHOLF, l.c.) festzustellen war. "»Stabilität« paart sich hier also mit starker

»Dynamik«" (REICHHOLF, l.c.), was sich auch in der Konstanz des Auftretens niederschlug: Diese verteilte sich keineswegs gleichmäßig über das Artenspektrum, sondern es überwogen die ganz unregelmäßig sowie die sehr regelmäßig auftretenden Arten, während Tagfalterarten mit mittlerer Konstanz unterrepräsentiert waren.
Im Tageslicht spielen bei der angewandten Methode der Linientaxierung - anders als bei Lichtfallenfängen - die Möglichkeit einer unvollständigen Erfassung des Artenspektrums eine sehr untergeordnete Rolle. Und dennoch kam es in punkto Turnover zu einem recht ähnlichen Ergebnis wie bei den Nachtfaltern in der vorliegenden Arbeit. Inwieweit sich die Befunde auch im Hinblick auf die Konstanz des Auftretens entsprechen, wird im folgenden geprüft werden.

6.4.2. Nachtfalter im Gitschtal (WIESER, 1987)

Auf der Suche nach geeignetem Vergleichsmaterial stößt man bei den Nachtfaltern schnell auf einen eklatanten Mangel an quantifizierten Artenlisten. Eine solche Quantifizierung wird oft mit dem Argument, die Mengenangaben haben nichts mit den tatsächlichen Abundanzen in der Natur zu tun, unterlassen, sie unterbleibt bisweilen jedoch wohl aus Angst vor Kritik. Auch wenn derartige Zahlenkolonnen natürlich nicht direkte Rückschlüsse auf Populationsgrößen erlauben, so bieten dennoch die relativen "Lichtfallen-Häufigkeiten" in bestimmten Fragestellungen wertvolle Informationen.
So kann die Nachtfalterfauna des Gitschtales (WIESER, 1987), die in Lichtfallenfängen der Jahre 1983-1986 erstellt wurde, gut für die Berechnung von Konstanz, Fluktuation und Turnover verwendet werden.
Das Problem, daß ein Zeitraum von 10 Jahren "als ein Mindestmaß einer verläßlichen Beobachtung populationsdynamischer Vorgänge" gelten kann (VARGA & UHERKOVICH, 1974), kennzeichnet die folgenden Berechnungen als vorläufig. Statistische Fehlerquellen werden hierbei zumindest teilweise durch die Betrachtung relativ großer Artengruppen kompensiert.

Der mittlere Turnover, errechnet aus drei Austauschraten, beträgt im Gitschtal 36,7 %.

Tab. 10: Konstanz, Turnover und Fluktuation im Gitschtal (Österreich) 1983-1986, errechnet aus WIESER (1987).
Constancy, turnover and fluctuation in the "Gitschtal" (Austria) from 1983 to 1986, calculated from WIESER (1987).

KONSTANZ *constancy*	ARTEN-Σ *species-Σ*	TURNOVER-EREIGNISSE *events of turnover*	TURNOVEREREIGNISSE / ART × JAHR *events of turnover per species and year*	VARIATIONS-KOEFFIZIENT *coefficient of variation*
25 %	102	137	0,45	200,0 %
50 %	59	110	0,62	129,1 %
75 %	74	115	0,52	91,9 %
100 %	222	-	0,00	58,7 %
GESAMT *total*	457	362	0,26	104,7 %

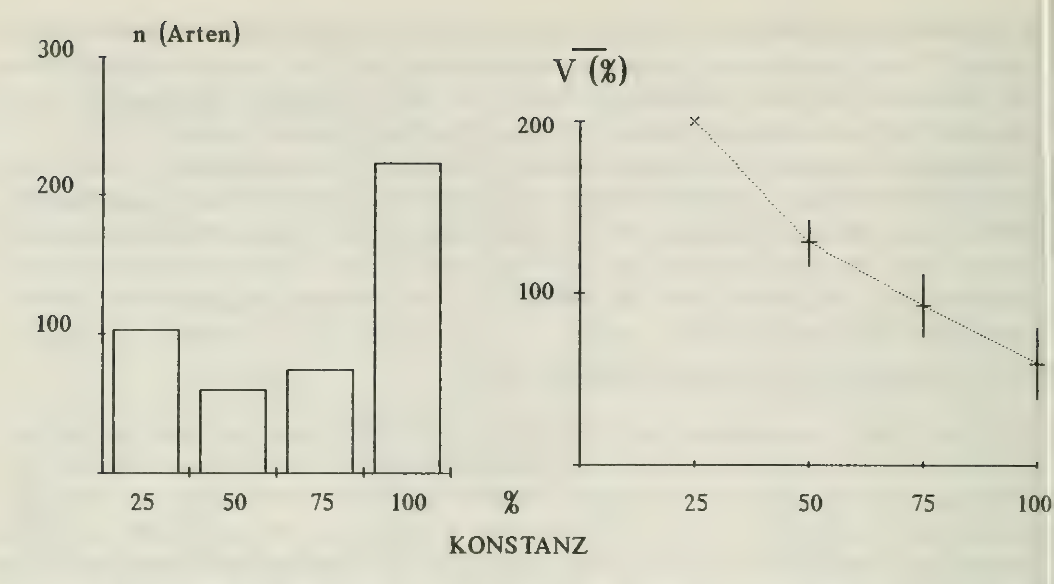


Abb. 5: Konstanz des Auftretens von Nachtfaltern im Gitschtal.
Constancy of moths in the "Gitschtal" (Austria).

Abb. 6: Variationskoeffizient ($\overline{V}$, mit Standardabweichung) in Abhängigkeit von der Konstanz bei Nachtfaltern im Gitschtal.
Coefficient of variation ($\overline{V}$, with Standard deviation) and constancy in the Gitschtal.

Die Abhängigkeit von der jeweiligen Artengruppe wird in Tabelle 11 ersichtlich.

Tab 11: Mittlerer Variationskoeffizient und Turnover verschiedener Artengruppen im Gitschtal (errechnet aus WIESER, l.c.).
Coefficient of variation and turnover of some systematic groups in the "Gitschtal".

ARTENGRUPPE *group of species*	VARIATIONSKOEFFIZIENT *coefficient of variation*	TURNOVER *turnover*
Bombyces und Sphinges	103,0 %	32,2 %
Noctuidae	102,0 %	33,2 %
Geometridae	108,9 %	44,0 %
(*Boarmiinae*	80,9 %	23,4 %)

Die Arten mit mittlerer Konstanz sind wie bei den Tagfaltern am unteren Inn unterrepräsentiert; es sind hier bei einer größeren Stichprobe (knapp 20.000 Individuen) und einem kürzeren Erfassungsintervall im Vergleich mit REICHHOLF (1986) die regelmäßig auftretenden Arten (rechter Teil der Kurve) etwas stärker vertreten. Dennoch wird ein nicht unbedeutender Teil des Artenspektrums sehr unregelmäßig nachgewiesen.

Konstanz und Fluktuation sind zwei streng negativ miteinander korrelierte Parameter. Die meisten Turnoverereignisse eines definierten Artenspektrums werden von den sehr

unregelmäßig auftauchenden Arten verursacht. Pro Art und Jahr gerechnet sind es allerdings die Arten mittlerer Konstanz, die die größten Austauschraten aufweisen. Das häufige Auftauchen und Verschwinden solcher Arten kann durch die Position der Lichtfalle in einer bestimmten Distanz zum typischen Habitat bedingt sein: Wird im Randbereich der potentiellen Dispersionsaktivität einer Art geleuchtet, werden verstärkt derartige Effekte auftreten (siehe Schlußbemerkungen zu 5.2.).

6.4.3. Nachtfalter in Oberschleißheim (Garten)

Im 5-Jahresintervall 1983/1985/1986/1987/1988 wurden nur ausgewählte Arten aus den *Bombyces*, *Sphinges* und aus der Familie *Noctuidae* berücksichtigt. In bezug auf die *Geometridae* gilt die in 6.1.2.1. angesprochene Problematik. Bei einigen weiteren Arten erschien die quantitative Vergleichbarkeit fraglich, sie wurden ebenfalls ausgeklammert.

Variationskoeffizienten aus 5-Jahresintervallen, wie sie in Tabelle 12 angegeben werden, können allerdings nicht direkt mit 4-Jahreswerten (WIESER, 1987 oder Tabelle 13) verglichen werden. Zur Abschätzung der Korrelation der verschiedenen Parameter liefern die folgenden Ergebnisse jedoch genügend Einzelinformationen.

Tab 12: Konstanz, Turnover und Fluktuation bei Nachtfaltern im Garten des Verfassers (SiN) in 5 Erhebungsjahren.
Constancy, turnover and fluctuation of Macroheterocera in the garden of the author in 5 trapping years.

KONSTANZ *constancy*	ARTEN-Σ *species-Σ*	TURNOVER-EREIGNISSE *events of turnover*	TURNOVEREREIGNISSE / ART × JAHR *events of turnover per species and year*	VARIATIONSKOEFFIZIENT *coefficient of variation*
20 %	46	72	0,39	223,6 %
40 %	29	60	0,52	142,1 %
60 %	24	51	0,53	113,9 %
80 %	27	43	0,40	92,8 %
100 %	39	-	0,00	69,5 %
GESAMT *total*	165	226	0,34	135,5 %

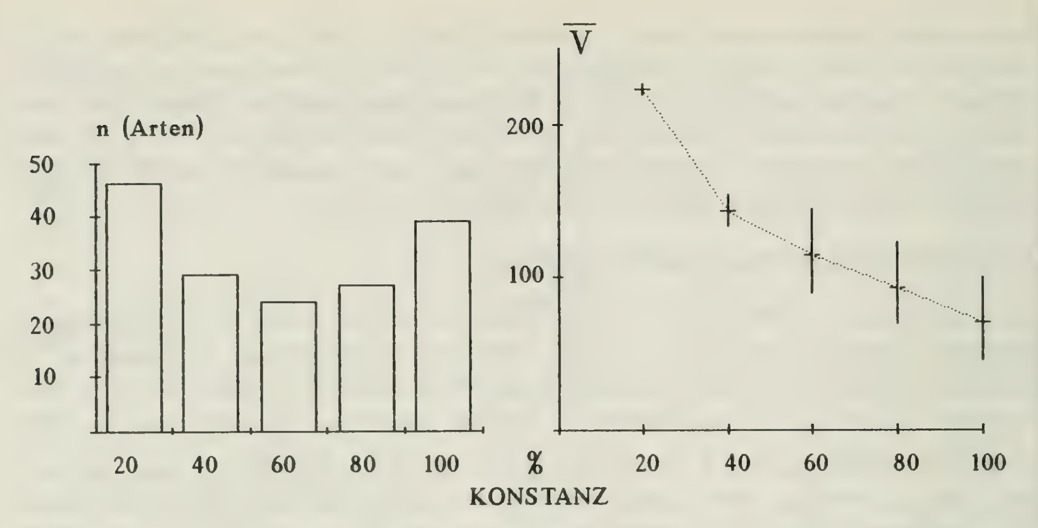


Abb. 7: Konstanz des Auftretens von Nachtfaltern im Garten.
Constancy of moths in the garden (Southen Bavaria).

Abb. 8: Variationskoeffizient ($\overline{V}$, mit Standardabweichung) in Abhängigkeit von der Konstanz bei Nachtfaltern im Garten.
Coefficient of variation ($\overline{V}$, with Standard deviation) and constancy in the garden.

Die Werte und Kurven ähneln im Prinzip den unter 6.4.1. und 6.4.2. gefundenen Verhältnissen.
Die konstanten Arten (100 %) zeigen eine etwas stärkere Fluktuationsdynamik als die des Gitschtales. Dies könnte auf größere anthropogene Störeinflüsse in Siedlungsgebieten (siehe 6.4.5.) zurückzuführen sein. Jedenfalls entspricht dieser Befund auch der im Gesamtbild festgestellten größeren Artenumsatz-Dynamik.

Nach verschiedenen systematischen Einheiten aufgegliedert, lassen sich folgende interessante Einzelwerte feststellen:

Tab. 13: Gegenüberstellung des mittleren Variationskoeffizienten und des mittleren Turnovers verschiedener systematischer Gruppen in unterschiedlichen Erfassungszeiträumen im Garten.
Mean of coefficient of variation and mean of turnover of various taxa in the garden.

	MITTLERER VARIATIONSKOEFFIZIENT *mean of coefficient of variation*	MITTLERER TURNOVER *mean of turnover*
(5 Erhebungsjahre) *5 years*		
Bombyces + Sphinges	138,9 %	62,8 %
Noctuidae	133,4 %	49,5 %

Tab. 13 (Fortsetzung)

	MITTLERER VARIATIONSKOEFFIZIENT *mean of coefficient of variation*	MITTLERER TURNOVER *mean of turnover*
(4 Erhebungsjahre: 1983, 1986, 1987, 1988) *4 years*		
Bombyces + Sphinges	131,3 %	62,5 % (n=47)
Noctuidae	121.1 %	49,2 % (n=122)
Geometridae	112,2 %	47,8 % (n=131)
- Unterfamilie *Boarmiinae*	96,7 %	28,9 % (n=42)
- Gattung *Eupithecia*	136,8 %	78,5 % (n=24)

Die gemittelten Variationskoeffizienten und der mittlere Artenumsatz einer definierten Artengruppe sind also offensichtlich miteinander korreliert. Bei stärkeren Fluktuationen kommt es statistisch häufiger zu Artenaustausch-Ereignissen.

Trotz der relativ hohen Turnoverraten und Fluktuationen bei den *Bombyces* und *Sphinges* ist bei einzelnen Arten die Konstanz der Populationen bemerkenswert, wie z.B. bei *Spilosoma menthastri* (100 % Konstanz, V = 25,0 %) oder *Spilarctia lubricipeda* (100 % Konstanz, V = 43,9 %). Dieser Einzelbefund deckt sich gut mit den Ergebnissen in REICHHOLF (1974).

Die in der Zeitspanne von 4 Jahren festgestellten Werte für die Spanner (*Geometridae*) und die Unterfamilie *Boarmiinae* stimmen erstaunlich gut mit dem Material aus dem Gitschtal (WIESER, 1987) überein. Die Boarmien, deren Raupen vorwiegend auf Bäume angewiesen sind, sind durch die geringen Fluktuationen und den niedrigen Artenumsatz als Arten gekennzeichnet, die stabile, relativ ortsfeste Populationen bilden. Dies steht im Einklang mit den extrem niedrigen Arten-Umsatzraten der Futterpflanzen.

Die erhöhte Dynamik der an SiN nachgewiesenen Eupithecienarten könnte z.T. im Zusammenhang mit instabileren Ressourcen stehen, zu berücksichtigen ist jedoch stets die Standortabhängigkeit solcher Phänomene: Am Fangplatz WaS beispielsweise scheinen sich die populationsdynamischen Prozesse bei den Arten der Gattung *Eupithecia* auf einem viel niedrigeren Niveau abzuspielen. Andersherum unterliegen die Boarmien im Offenland (HM) einem relativ hohem Artenaustausch. Eine hohe Ortstreue der Eupithecien konstatieren auch VARGA & UHERKOVICH (1974).

6.4.4. Nachtfalter in Oberschleißheim (Offenland: "HM" und "HO")

Im Flughafengebiet (HM und HO) stehen leider nur Ergebnisse aus drei Erhebungsjahren (1986, 1987, 1988) zur Verfügung, wodurch Randeffekte, die zu einer Verzerrung der Ergebnisse führen können, stärker in Erscheinung treten. Es wird sich aber zeigen, daß sich dies durch die Fülle des Materials (über 200 Arten an HM) wohl zum großen Teil gegenseitig ausgleicht und aufschlußreiche Folgerungen zuläßt.
Besonders wertvoll ist eine genauere Analyse der Verhältnisse im reinen Offenland (HM), da hier die Abgrenzung der Habitate in einer schärferen Weise erfolgen kann (vergleiche 6.2.):

Tab. 14: Konstanz des Auftretens verschiedener Macroheteroceren-Taxa im Offenland (HM).
Constancy of some Macroheterocera-Taxa in the open grassland (HM).

KONSTANZ *constancy*	*BOMBYCES + SPHINGES*	*NOCTUIDAE*	*GEOMETRIDAE*	$\sum$
33,3 %	13	44	32	89
66,6 %	15	25	21	61
100 %	14	48	9	71
Arten-Σ *species-Σ*	42	117	62	221

Den tatsächlich festgestellten Kurvenverlauf der Konstanz, der ganz im Einklang mit dem bereits diskutierten Befund einer Unterrepräsentation der Arten mittlerer Konstanz steht, kann man sich nun in einem vereinfachten Modell als aus zwei Komponenten zusammengesetzt vorstellen. Hierzu soll von einer hypothetischen scharfen Einteilung in "biotoptypische", und "biotopfremde" Arten ausgegangen werden. Folgende Einzelverteilungen bezüglich der Regelmäßigkeit des Auftretens sind zu erwarten:

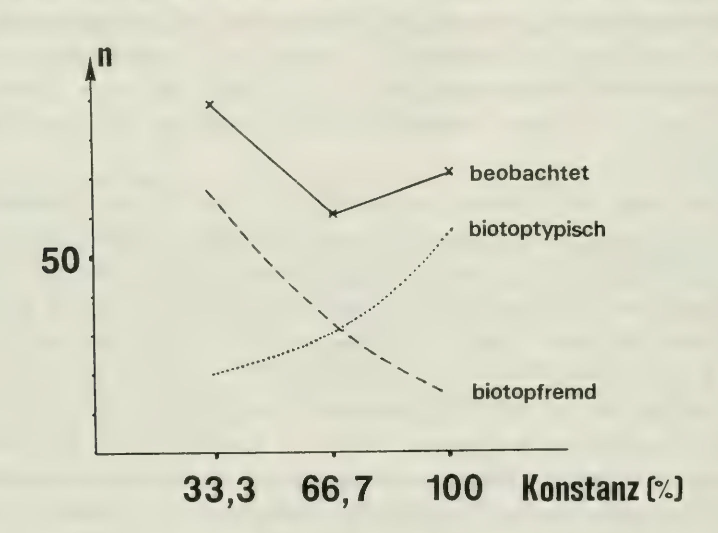


Abb. 9: Beobachtete und erwartete Konstanz des Auftretens, aufgeschlüsselt nach der Bodenständigkeit der Arten.
Observed and expected constancy of species occurrence, separated into the categories 'habitat specific' (dotted line) and 'origin off site' (of capture) (broken line). The solid line gives the observed distribution of constancy.

Je weiter "das Heimathabitat" von der Falle entfernt ist, umso weiter sollte sich in Abb. 9 die Kurve der Gastarten nach links verschieben. Je großflächiger und ungestörter der typische Lebensraum um die Falle herum ist, umso steiler wird der Kurvenverlauf der potentiell bodenständigen Arten sein.
Die Verteilung der Familie der Spanner (*Geometridae*) in den verschiedenen Konstanzklassen entspricht ziemlich genau der postulierten Kurve für biotopfremde Arten. Lenkt man das Augenmerk darauf, daß der Wald für HM einen solchen entfernten Biotop

darstellt und die Spanner vorwiegend Wald-, bzw. Waldrandarten sind, so scheint schon dies ein erster Anhaltspunkt für eine Bestätigung der Hypothese zu sein.
Da jedoch in den allerwenigsten Fällen ein solches 2-Biotope-Modell vorliegen wird, sondern Überlagerungen von mehreren, verschieden weit entfernten Zuwanderungsquellen, so werden, falls Beurteilungen überhaupt möglich sind, differenziertere Tests vonnöten sein.

Hierzu wurde das an HM nachgewiesene Artenspektrum über eine genauere Betrachtung der in der Literatur angegebenen Raupenfutterpflanzen, z.T. durch eigene Beobachtungen präzisiert, in drei verschiedene Kategorien eingeteilt: Es können potentiell bodenständige Arten von solchen abgetrennt werden, die entweder aus mindestens 150-300 m oder aus über 800 m Entfernung stammen müssen (siehe 6.2.). Es handelt sich also um Mindestangaben. Andere Kleinstbiotope spielen in der näheren Umgebung auf dem Flughafen eine nur sehr untergeordnete, zu vernachlässigende Rolle.

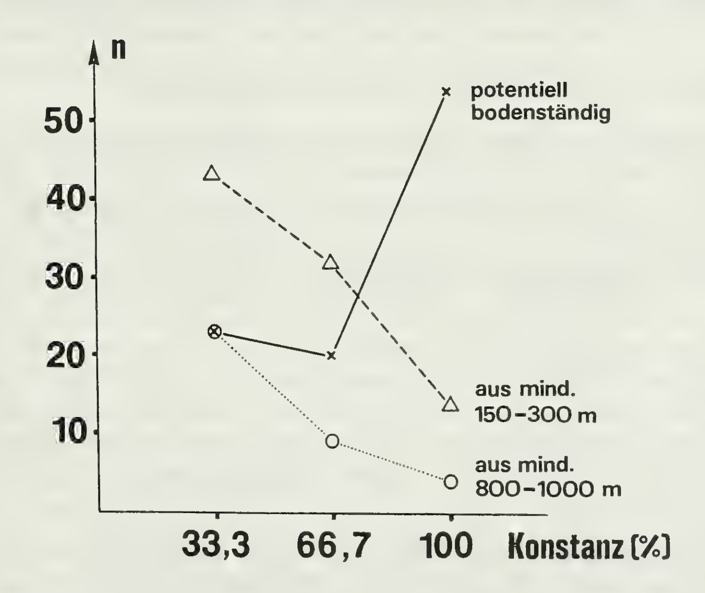


Abb. 10: Beobachtete Konstanz des Auftretens bei Nachtfaltern verschiedener "Heimat-Habitate" im Offenland (HM).
Constancy of occurrence in the light-trap-captures in relation to distance of the species' breeding sites (solid line = highly probable in site propagation, broken line = distance 150 to 300 metres, dotted line = distance 800 to 1000 metres).

Abb. 10 bestätigt nun die eingangs aufgestellten Überlegungen:

- Der rechte Teil der Kurve (also die regelmäßig auftretenden Arten) besteht fast ausschließlich aus den potentiell bodenständigen Arten, während der linke Teil überwiegend von den zugeflogenen Gästen beherrscht wird. Das jedoch bedeutet, daß die in Lichtfallenausbeuten festgestellte Konstanz des Auftretens als Parameter der Populationsdynamik durchaus mit real in der Natur ablaufenden Prozessen verknüpft ist.

Es handelt sich mit höchster Wahrscheinlichkeit nicht nur um den unregelmäßigen Nachweis von ständig anwesenden Arten, sondern tatsächlich um ein unregelmäßiges Auftreten. Dies wiederum bekräftigt den Aussagewert des in Lichtfallen-Artenspektren auftretenden Turnovers!

- Mit zunehmender Entfernung der Ausgangs-Habitate verschiebt sich die Teilkurve der biotopfremden Arten weiter nach links, wie dies im Falle der vom Flughafenrand (800-1000 m) stammenden Nachtfalter geschah. Das Auftreten einer Art wird also mit zunehmender Entfernung vom Habitat unregelmäßiger.

Schon im Gesamtbild (siehe 6.2.) fallen die in verstärktem Maße fehlenden Waldarten auf. Eine Vielzahl von Arten dieses Lebensraumtyps, die in ca. 1 km Entfernung (z.B. an HO) nachgewiesen werden konnte, ist also mit 0 % Konstanz zu veranschlagen.

An anderen Standorten ist eine Beurteilung schwieriger, da sich die Effekte einer Vielzahl mehr oder weniger kleiner Lebensräume verschiedenster Entfernungen überlagern und das im reinen Offenland so klar ausgeprägte theoretische Modell im Gesamtbild verwischen.

Am Flughafenrand (HO) ergibt sich beispielsweise folgendes Bild:

Tab. 15: Konstanz des Auftretens verschiedener Macroheteroceren-Taxa am Flughafenrand (HO).
Constancy of some Macroheterocera-Taxa at the edge of a wood (HO).

KONSTANZ *constancy*	*BOMBYCES + SPHINGES*	*NOCTUIDAE*	*GEOMETRIDAE*	Σ
33,3 %	14	32	29	75
66,6 %	12	30	35	77
100 %	31	76	60	167
Arten-Σ *species-Σ*	57	138	124	319

Die regelmäßig auftretenden Arten sind hier stärker vertreten, was dadurch erklärt wird, daß an diesem Waldrand-Standort sowohl Waldarten wie auch Offenlandarten als "biotoptypisch" angesprochen werden können. Diese auf den Standort bezogene verringerte Artenspektrendynamik schlägt sich in ebenfalls deutlich niedrigeren Artenumsatz-Raten nieder als im Offenland.

6.4.5. Eulenfalter (Noctuidae) in Südböhmen und England

Umfangreiche, auf sehr großen Stichproben beruhende Auswertungen von Lichtfallenfängen in Südböhmen und England ergaben wertvolle Informationen v.a. in bezug auf die Fluktuationsdynamik. Die im folgenden kurz skizzierten Ergebnisse stützen sich auf die Publikationen von REJMANEK & SPITZER (1982), SPITZER, REJMANEK & SOLDAN (1984), GLAZIER (1986), GASTON (1988) und SPITZER & LEPS (1988). Einleitend muß darauf hingewiesen werden, daß in diesen Arbeiten nur *Arten mit einer gewissen Mindestkonstanz des Auftretens* bzw. *einer Mindestabundanz* berücksichtigt wurden. Dies ist bei Vergleichen stets zu bedenken.

Nach SPITZER, REJMANEK & SOLDAN (1984) sind Variationskoeffizient und potentielle jährliche Wachstumsrate der Population (PGR) miteinander stark positiv korreliert. Die Arten mit den höchsten festgestellten Variationskoeffizienten sind r-Strategen, ihre Raupen sind polyphag.
Wie wir im vorigen Abschnitt (6.4.4.) gesehen haben wurden durch die bevorzugte Verwendung konstant auftretender Arten bei diesen Berechnungen v.a. die potentiell bodenständigen Arten erfaßt und statistisch verwertet. Außerhalb ihrer Habitate können auch tendenziell von K-Strategen beherrschte Gruppen mitunter höhere Variationskoeffizienten aufweisen. Am Standort SiN trifft dies vielleicht bei den Eupithecien (6.4.3.) zu. Hier waren bei den Berechnungen auch die unregelmäßig auftretenden Arten hinzugezogen worden. Die Boarmien reagierten als K-Strategen mit niedrigen Fluktuationen jedoch ganz im Sinne der o.g. Autoren.

Die Absolutwerte der in REJMANEK & SPITZER (1982) publizierten Variationskoeffizienten für Arten ab einer Konstanz von 25 % (3 von 12 Jahren) liegen bei durchschnittlich 94,6 %. Sie sind mit Werten aus unterschiedlichen Erfassungszeiträumen jedoch nicht direkt vergleichbar. Die relativen Abweichungen vieler Arten von diesem Mittelwert entsprechen zumeist den Ergebnissen im Gitschtal und aus dem Untersuchungsgebiet.

Das Ausmaß der Abundanzschwankungen ist von der jeweils untersuchten Artengruppe abhängig (REJMANEK & SPITZER, l.c.): Wanderfalter und schädliche Arten, vor allem die der Landwirtschaft, zeigen hohe Variationskoeffizienten, hygro- und mesophile Arten des Graslandes sowie die Bewohner von "Baum- und Gebüschformationen" unterliegen dagegen geringeren Fluktuationen. Dies deckt sich mit den Beobachtungen im Untersuchungsgebiet.

Die positive Korrelation von Variationskoeffizient und PGR belegen auch SPITZER & LEPS (1988). Dieselben Autoren fügen hinzu, daß in einem Klimax-Ökosystem die Häufigkeiten der Arten konstanter sind als in Ökosystemen früher Sukzessionsstadien mit größeren Störeinflüssen. Für diesen Vergleich hatten sie die Variationskoeffizienten der jeweils gleichen Arten herangezogen. Ephemere Lebensräume werden darüber hinaus von einer größeren Artenzahl an r-Strategen besiedelt. Dies könnte eine Erklärung dafür sein, daß im Siedlungsgebiet von Oberschleißheim (anthropogene Störeinflüsse relativ groß) etwas höhere Fluktuationen festzustellen waren, als beispielsweise im Gitschtal. Diese größeren Häufigkeitsschwankungen führen statistisch häufiger zu einem lokalen Verschwinden von Arten und damit zu einem höheren Turnover als an anderen Standorten.
Populationen lokal vorkommender Arten, die als K-Strategen relativ stabile Ressourcen und Habitate benutzen, besitzen niedrige Variationskoeffizienten (GLAZIER, 1986; GASTON, 1988).

7. RÜCKSCHLÜSSE AUS DEN HÄUFIGKEITSVERTEILUNGEN

7.1. ARTENZAHL UND STICHPROBENGRÖSSE

In einer ersten Betrachtung könnte man die höheren Umsatzraten im Garten (SiN) und im Offenland (HM) auf die relativ geringen Individuenzahlen (ca. 1700 bzw. 1000 Individuen pro Jahr) an diesen Standorten zurückführen und behaupten, daß hier durch geringere Erfassungsgenauigkeit ein größerer Einfluß methodisch bedingter Fehler vorliegt.

Die Abhängigkeit der Artenzahl von der Menge der gefangenen Individuen (ein Maß der Diversität) - bezogen auf Jahressummen jeweils eines Standorts - geht aus Abbildung 11 hervor.

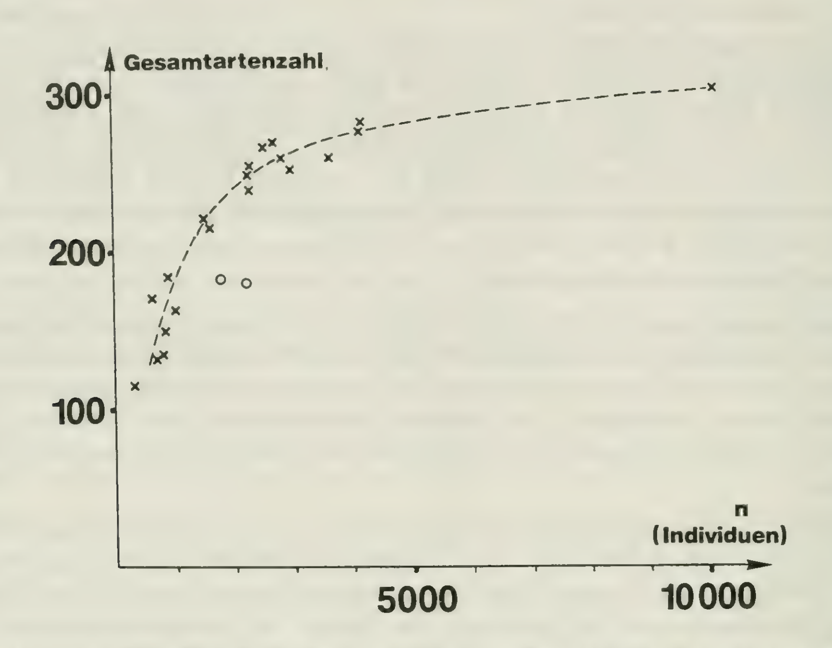


Abb. 11: Artensumme pro Jahr in Relation zur Individuenzahl; mit Kreis sind die Fangplätze We und Mb gekennzeichnet, mit x die übrigen Fangplatz-Jahresergebnisse.
Total species per year and number of individuals; o = *two localities in wet woods ("We" and "Mb");* x = *the results of the other localities.*

Große Individuenzahlen pro Jahr bedeuten bei definierten Einzugsbereichen der Falle aber auch biologisch reichhaltigere Habitate, die von Natur aus mehr Arten beinhalten. Andersherum ausgedrückt ist die Stichprobengröße im Garten und im Offenland relativ gesehen mit der der anderen Standorte vergleichbar, da die Proben aus einem kleineren Individuen-Pool entnommen wurden.
Relativ stark aus dem Rahmen fallen die zwei mit Kreis gekennzeichneten Werte im Dachauer Moos (We, Mb). Sie liegen vor allem wegen der überaus großen Häufigkeit des Spanners *Calospilos sylvata* unter dem Niveau der anderen Fangplätze. Diese niedrigere Diversität könnte entsprechend den Ergebnissen MADERs (1980) in Zusammenhang mit der Störung des Lebensraumes durch die Zurückführung des ehemaligen Niedermoors auf wenige <u>kleinflächige</u> Reliktstandorte und durch Einflüsse seitens der Landwirtschaft von den Rändern dieser Restflächen her stehen. Deren Moorcharakter ist seit vielen Jahren durch den stark gesunkenen Grundwasserspiegel verlorengegangen. Die Stichprobenentnahme erfolgte an den drei Standorten im Dachauer Moos jedoch mit geringerer Frequenz als an den anderen Stellen. Diese Problematik soll in Kapitel 7.3. besser beleuchtet werden.
Zur Abschätzung von Fehlerquellen bezüglich der Erfassungsgenauigkeit sollte man vielleicht eher einzelne Standorte im Lauf der Jahre unter Berücksichtigung der Dominanzstrukturen heranziehen.

7.2. VERGLEICH MIT DEN "log-series" WILLIAMS (1964)

Teilt man das 1987 und 1988 im Untersuchungsgebiet erarbeitete Artenspektrum in der Weise ein, wie dies WILLIAMS (1964) in seinen Auswertungen des Fangergebnisses der Lichtfalle in Rothamsted tat, so ergibt sich bei einer Zuteilung in die einzelnen geometrischen ×3-Klassen das in Abb. 12 gezeigte Bild.

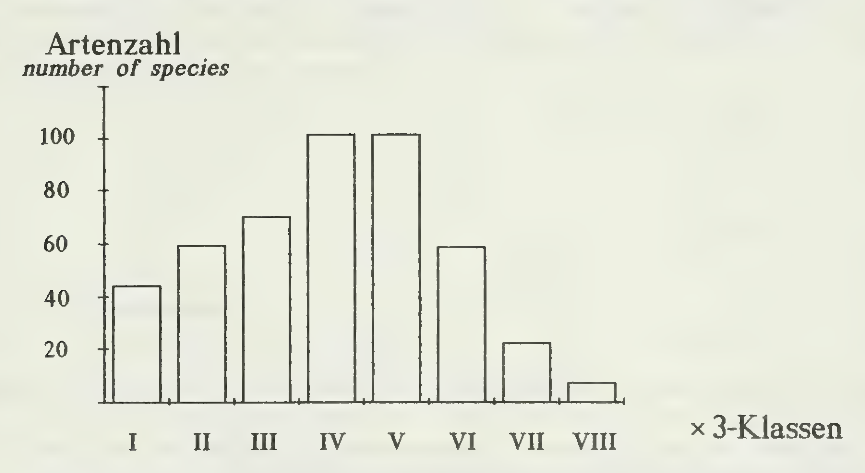


Abb. 12: Häufigkeitsverteilung der in den Lichtfallenfängen 1987 und 1988 nachgewiesenen Arten in ×3-Klassen.

I = 1 Individuum	IV = 14-40 Individuen	VII = 365-1093 Individuen
II = 2-4 Individuen	V = 41-121 Individuen	VIII = › 1093 Individuen
III = 5-13 Individuen	VI = 122-364 Individuen	

Abundance structure (in ×3 geometric classes) of species of Macroheterocera, caught by light-trap-captures 1987 and 1988.

Die Verteilung ähnelt am meisten derjenigen eines 8 Jahre dauernden, täglich erfolgten Lichtfanges in Rothamsted bei einer Ausbeute von knapp 33.000 Individuen.

In bezug auf die Problematik der Erfassungsgenauigkeit interessieren uns nun vor allem die selteneren Arten der ersten beiden Klassen an Einzelstandorten, sind es doch gerade diese seltenen Arten, die in verstärktem Maße am Turnovergeschehen beteiligt sind (SCHOENER, 1983).

7.3. ZUM PROBLEM DER ERFASSUNG DER SELTENEN ARTEN

7.3.1. Artenzahl und Fangrhythmus

Aus der Überlegung heraus, daß sich die beobachtete Artenzahl bei einer Optimierung der Methode durch steigende Anzahl von Fangnächten pro Jahr an einen maximalen Wert annähern sollte, soll nun die Abhängigkeit vom Fangrhythmus näher beleuchtet werden. Durch ein auf die Fänge 1988 im Garten (WaS) gelegtes Raster wird getestet, wieviele Arten nachgewiesen worden wären, wenn nur in jeder zweiten, vierten u.s.w. Nacht geleuchtet worden wäre. Die Grundlage bilden die Ergebnisse aus den Fängen in einem mittleren Rhythmus von 1,15 Tagen von Mai bis August bzw. von 1,45 Tagen von April bis Oktober.

Das Ergebnis zeigt Abb. 13:

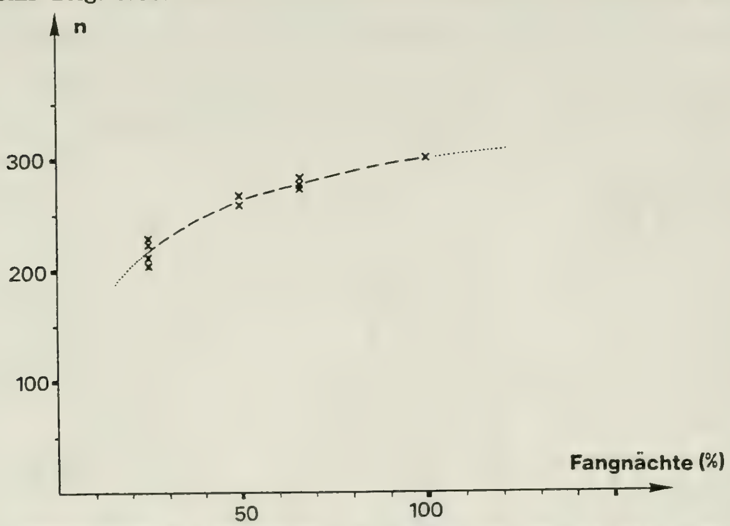


Abb. 13: (Hypothetische) Artensumme n in Relation zur Anzahl der Fangnächte pro Jahr (in % der 182 Gesamtfangnächte) am Standort WaS 1988.
Correlation of species number (n) and number of captures per year (in % of the total of 182 nights) 1988 in the garden (Southern Bavaria).

Die Kurve zeigt eine Annäherung an einen Wert von 325 Arten im Jahr 1988. Wenn man bedenkt, daß bei langjährigen Beobachtungen im Garten bisher 411 Arten nachgewiesen werden konnten, ist dies ein weiteres Argument dafür, daß in den Ergebnissen der Einzeljahre tatsächlich Arten fehlen und das Artenspektrum somit einem mehr oder weniger großen Artenumsatz von Jahr zu Jahr unterliegt.
Bei fast kontinuierlichem Betrieb der Lichtfalle scheinen etwas über 90 % des Artenspektrums nachgewiesen werden zu können. Für jede 2. Fangnacht errechnet sich ein theoretischer Wert von 262,5 Arten (81 %); im Jahr 1987 waren bei einem (vergleichbaren) durchschnittlichen Fangnachtabstand von 2,3 Tagen (Mai-August) bzw. 2,6 Tagen (April-Oktober) real 240 Nachtfalterarten beobachtet worden. Durch täglichen Fang werden viele Individuen länger an der Lichtquelle festgehalten, als es einem natürlichen Aufenthalt im Einzugsbereich der Falle ohne Lichteinfluß entsprechen würde. Dadurch kommt es zu einer leichten Überschätzung der theoretisch ermittelten Artenzahlen für die Hälfte der Fangnächte. Dies fällt aber offensichtlich ab einer gewissen Fülle von Einzelinformationen (> 10.000 gefangene Individuen) nicht mehr so stark ins Gewicht. Die Frage bleibt offen, inwieweit die Jahre 1987 und 1988 von der Witterung her zu vergleichen sind.
In einem weiteren Test der Abhängigkeit der Artenzahl von der Fanghäufigkeit zeigte die Familie *Noctuidae* im Jahr 1986 ähnliche Ergebnisse, obwohl hier fangfreie Nächte zwischen den Stichprobenentnahmen lagen. Die Berechnungen stützen sich auf das Fangergebnis im Garten am Fangplatz SiN. Die Gesamtartenzahl nähert sich an einen Wert von ca. 125 Arten an. Bei Fangnachtabständen von durchschnittlich 2,3 Tagen

(Mai-August) und 2,0 Tagen (April-Oktober) waren demnach 79 % in der Probeentnahme enthalten, in der Hälfte dieser Fangnächte waren es noch 66 %. Im Jahr 1988 (WaS, alle Nachtfalterarten) betrugen die entsprechenden Werte 81 % bzw. 68 %!

7.3.2. PRESTONs "veil-line"-Theorie

Bei der Betrachtung der Häufigkeitsverteilung des am Flughafenrand (HO) für das Jahr 1988 nachgewiesenen Nachtfalter-Artenspektrums zeigt sich eine Dominanz der Arten, die in 2-4 Individuen festgestellt wurden:

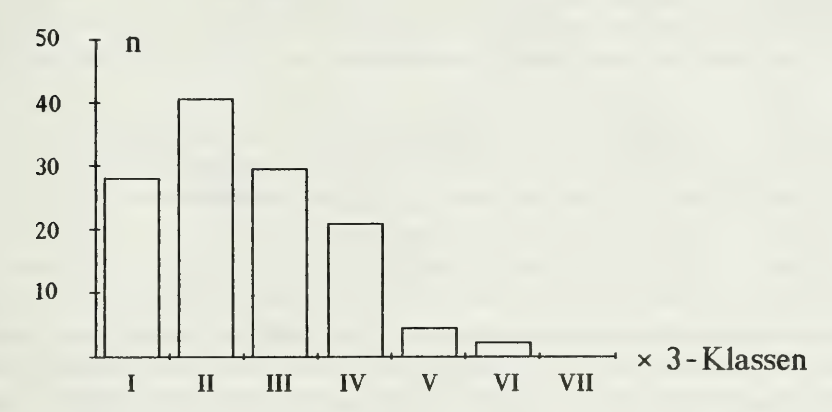


Abb. 14: Häufigkeitsverteilung der am Flughafenrand (HO) 1988 nachgewiesenen Macroheteroceren in × 3-Klassen (Legende siehe Abb. 12).
Abundance structure of Macroheterocera (in × 3—classes), captured 1988 at the edge of a wood ("HO").

PRESTON (1948) unterstellte für derartige Häufigkeitsstrukturen eine lognormale Verteilung (vergleiche auch MAY, 1980), bei der wie im vorliegenden Fall durch eine begrenzte Stichprobenentnahme ein Teil der Kurve "abgeschnitten" wurde. Er nannte diesen "Schnitt" bei den Individuen, die nur in einem Exemplar festgestellt wurden "veil line". Die Arten links davon waren in der Stichprobe nicht enthalten, hätten aber in einer anderen auftauchen können (WILLIAMS, 1964).

Trägt man nun die aufsummierten prozentualen Anteile der Klassen I-VI an der Gesamtartenzahl gegen den Logarithmus der Klassenobergrenze auf (Abb. 15), so erhält man unter der Annahme eines Nullwertes von 0 Arten einen etwas asymmetrischen Kurvenverlauf. Dieser kann nun nach WILLIAMS (l.c.) auf der Basis größtmöglicher Symmetrie durch eine Nullwert-Hypothese korrigiert werden (Abb. 15).

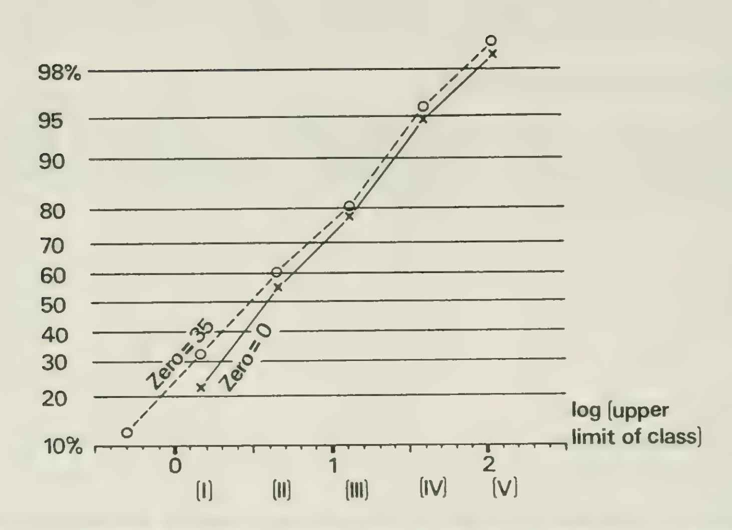


Abb. 15: Aufsummierte prozentuale Anteile der × 3 - Klassen an der Gesamtartenzahl mit und ohne Annahme eines Nullwertes am Fangplatz HO 1988 (vgl. WILLIAMS, 1964).
Accumulated percentage of the × 3 - classes of the total species on the assumption of no zero value and on the assumption of a zero value of 35 (see WILLIAMS, 1964).

Führt man diese Operation bei den Artenspektren aller drei Erhebungsjahre an HO durch, so kommt man bei einer durchschnittlichen Gesamtartenzahl von 256 Arten auf einen (hypothetischen) mittleren Nullwert von ca. 50 Arten.
Aus der Gesamt-Häufigkeitsstruktur der an diesem Standort 1986-1988 gefangenen Nachtfalter (338 Arten) ergibt sich ein Nullwert von 40 Arten.
Diese Angaben könnte man benutzen, um die Arten-Zeit-Kurve (siehe 5.1.) zu korrigieren. Im ersten Jahr würde unter Annahme der oben genannten Nullwerte dann durchschnittlich knapp 3/4 des Artenspektrums nachgewiesen werden können (statt ca. 60 %). Der Turnover würde sich von ca. 40 % auf ungefähr 30 % korrigieren.

Mit einer anderen Vorgehensweise waren wir schon an anderer Stelle (7.3.1.) zu einem fast identischen Ergebnis gekommen: Bei einer Optimierung der Fangintensität wären im Garten nach zwei voneinander unabhängigen Berechnungen (WaS, SiN) ungefähr 3/4 der hochgerechneten langjährigen Gesamtartenzahl in einem Einzeljahr nachzuweisen gewesen (statt ca. 60 %).

Hervorzuheben ist allerdings der hypothetische Charakter dieser Aussagen, da offenbleibt, inwieweit sich ein solcher theoretisch ermittelter Nullwert mit der tatsächlich unter der Erfassungsschwelle gebliebenen Artenzahl deckt!

Zu einer derartigen Beurteilung wären direkte Nachweise von methodisch bedingten Artefakten nötig. Am Flughafenrand (HO) konnten beispielsweise im Sommer 1986 Raupen von *Eupithecia tripunctaria* und 1988 Raupen von *Thyatira batis* gefunden werden. Die jeweiligen 1. Generationen mußten also mit mindestens einem ♀ im Gebiet vertreten gewesen sein, obwohl in den betreffenden Jahren am Licht kein Imago beobachtet wurde. Der von *Thyatira batis* verursachte Turnover kann daher als methodisch bedingt charakterisiert werden, bei *Eupithecia tripunctaria* ergibt sich jedoch ein zusätzliches Turnoverereignis.
Derartige Einzelinformationen sind, gemessen an der Größe des Artenspektrums, nur Mangelware und werden auch bei einer Optimierung anderer Methoden nie zu einem umfassenden Bild des Anteils methodischer Störeinflüsse im apparenten Turnover führen.

Wertvolle Zusatzinformationen kann dagegen eine Betrachtung der Dynamik auf dem Art-Niveau liefern. Wenn sich zeigen sollte, daß ein großer Teil des Artenspektrums einer ausgeprägten Populationsdynamik unterliegt und die jeweilige Besiedelung eines Habitats stark von einem Fließgleichgewicht abhängt, das durch ständige "Trittstein-Sprünge", d.h. durch ein Neu-Aufsuchen, Bodenständig-Werden (mehr oder weniger kurzzeitig) und bei Störungen durch ein Wieder-Verschwinden seitens der Arten entsteht, so sollte dies ein weiterer Hinweis darauf sein, daß der apparente Turnover eine tatsächlich stattfindende Dynamik wiederspiegelt. Der apparente Artenumsatz mag numerisch nicht ganz exakt sein, er stellt aber vielleicht eine brauchbare Annäherung der Verhältnisse dar.
Hierzu sollen im II. Teil vor allem die Dispersionsaktivitäten der Arten in Zusammenhang mit Verbreitungsstrategien betrachtet werden.

II. EXPERIMENTELLER TEIL: DISPERSIONSVERHALTEN UND TRIVIAL MOVEMENT

8. DIE EXPERIMENTE

8.1. VORSTELLUNG DER MARKIERUNGSEXPERIMENTE

8.1.1. Allgemeines

Unter "Dispersionsdynamik" versteht man nach SCHWERDTFEGER (1978) "den durch Ortswechsel ihrer Glieder sowie durch Dichteänderung bewirkten Wandel in der örtlichen Verteilung der Population".
Die Auftrennung der Nachtfalter-Flugaktivitäten in Dispersions- und Migrationsverhalten einerseits und "trivial flights" andererseits soll im Sinne JOHNSONs (1969) verstanden werden (siehe Kapitel 12).
Zur Erforschung dieses Fluggeschehens sind drei Wege zu unterscheiden (REINHARDT & DROBNIEWSKI, 1979):
- die Erfassung offensichtlich zugeflogener Arten,
- das Markieren und Freilassen von Faltern und
- zusätzliche experimentelle Arbeiten.

Insgesamt wurden im Untersuchungsgebiet über 23.800 Falter aus 131 Arten markiert. Die Artauswahl richtete sich nach folgenden Kriterien:
- Abdeckung der Bandbreite verschiedener Taxa (Familien, Unterfamilien)
- Unterschiedliche Ökotypen
- Unterschiedliche Flugzeiten (auch Arten, die unter extremen Bedingungen fliegen)
- Unterschiedliche Körpergrößen
- Unterschiedliche Abundanz (insgesamt gesehen, wurden jedoch häufigere Arten bevorzugt)
- Repräsentanz von uni- und bivoltinen Arten
- Wanderfalter als "Nullprobe" geringer Ortstreue

8.1.2. "Fern"-Wiederfänge

Durch das Betreiben eines ganzen Standortnetzes (siehe 2.2., Abbildung 1) sollte getestet werden, ob auf Distanzen von 400 m (SiS→SiM) bis 3,25 km (FW→WaN) Dispersionsaktivitäten markierter Nachtfalter direkt durch Wiederfang an einer anderen Stelle nachgewiesen werden können.
Zur Technik der Markierungen siehe Kapitel 3.4..

8.1.3. Verringerte Fallendistanzen

Nachdem 1987 über die oben angeführten Distanzen bei 7617 markierten Faltern nur 2 Ortswechsler nachgewiesen werden konnten, wurde im Wasserwerk ein Parallelfang-Versuch mit Fallenentfernungen gestartet, die ungefähr eine Zehnerpotenz unter denen des Jahres 1987 lagen (siehe 2.2., Abbildung 2). Der Fang erfolgte mit einer Frequenz von ca. 2-3 Tagen über das ganze Jahr.

8.1.4. Versetzexperiment

Um abschätzen zu können, welchen Anteil am Anflugverhalten die direkte Lichtattraktion hat, und inwieweit Dispersionsaktivitäten eine Rolle spielen, wurde 1988 im Waldstreifen

hinter dem Garten (Fangplatz WaS) ein Versetzexperiment durchgeführt: Die Wiederfang-Wahrscheinlichkeiten von Tieren, die an der Falle freigelassen wurden, geben im Vergleich mit solchen, die in 30 m/60 m/90 m und 120 m Entfernung freigelassen wurden, Aufschlüsse über die Anteile solcher Einflüsse.
Es wurde hierzu an WaS täglich geleuchtet, um "Verlustkurven" besser dokumentieren zu können. Aus diesem Grund wurden auch die Wiederfänge in fast allen Fällen bei "0 m" (=Radius von ca. 7-8 m um die Falle herum, siehe 3.3.) ausgesetzt. Für das Versetzexperiment wurden einige genügend häufige Arten ausgewählt.

Im Torfeinfang erfolgten 1988 einige Versuche an der Spannerart *Calospilos sylvata*, um eine relativ ortsfeste Population mit hoher Populationsdichte auf deren Antworten auf die Versuchsbedingungen zu testen.

Die Versetzdistanzen wurden im Garten laufend von Nacht zu Nacht vergrößert, so daß in der jeweiligen 6. Nacht wieder bei 0 m begonnen werden konnte. In anderen Fällen (z.B. bei *Alcis repandata* und *Peribatodes rhomboidaria*) wurde stets die Hälfte der Exemplare bei 0 m und die andere Hälfte bei der jeweiligen Versetzdistanz freigelassen, um durch eine Bereinigung mit Hilfe des mittleren "Null-Wertes" die Ergebnisse aus den verschiedenen Entfernungen unabhängiger gegen Störeinflüsse zu machen (z.B. Witterung). Die errechneten bereinigten Ergebnisse entsprachen jedoch in allen Fällen denen, die ohne diese Maßnahme zustandegekommen wären.

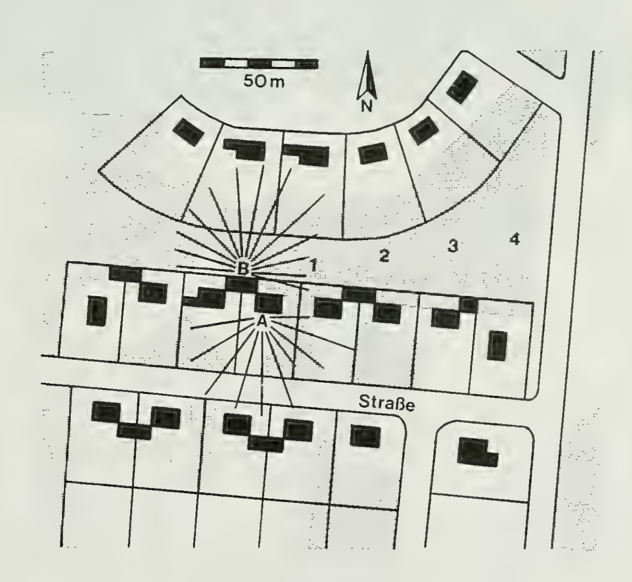


Abb. 16: Garten des Verfassers mit den Fangplätzen SiN (A) und WaS (B); markierte Tiere wurden in 30 m (1), 60 m (2), 90 m (3) und 120 m (4) Entfernung freigelassen; Flächen mit überwiegendem Waldcharakter (Kronenschluß) sind mit Raster gekennzeichnet.
Garden of the author (SiN = A; WaS = B); marked specimens were released at distances of 30 m (1), 60 m (2), 90 m (3) and 120 m (4); reticulate: wood character.



Abb. 16b: Nähere Umgebung des Fangplatzes WaS.

Im Grunde genommen stellen auch die 30 m südlich des Standorts WaS an SiN markierten Falter "versetzte" Exemplare dar, deren Anflug an WaS in den für SiN fangfreien Nächten getestet wurde. Durch Vergleich mit den im Waldstreifen bei 30 m freigelassenen Tieren ergeben sich Hinweise auf die Einflüsse der schlechteren Einsehbarkeit der Lichtquelle sowie der vielleicht als Barriere wirkenden Häuser- und Garagenzeile (2-10 m hoch).
Die Einsehbarkeit der Lichtquelle war bei keiner der vier Freilaß-Punkte gegeben, bei 30 m war diese jedoch nur durch einen Busch verstellt.

8.1.5. Rückschlüsse aus Ortswiederfängen

Die mit einigen Problemen behafteten Interpretationen von Ortswiederfängen bei Nachtfaltern können bei Berücksichtigung der Fehlerquellen (siehe 8.5.) in vielen Fällen Aufschlüsse über populationsdynamische Vorgänge liefern.
Nach BETTMANN (1986) benötigt man eine Stichprobe von mindestens 100 markierten Faltern, um einigermaßen repräsentative Ergebnisse zu erhalten. Dies war im Untersuchungsgebiet bei 50 Arten der Fall.

8.2. "FERN-" WIEDERFÄNGE

8.2.1. Übersicht

Tab. 16: Wiederfänge über Mindestdistanzen (Luftlinie) ab 1 km 1987 und 1988 im Untersuchungsgebiet.
Recaptures over distances of at least 1 km 1987 and 1988 in the study area.

JAHR *year*	ART *species*	GESCHLECHT *sex*	STRECKE *route*	DISTANZ (km) *distance (km)*	INTERVALL (Tage) *interval (days)*
1987	*Scotia clavis*	♂	HW→SiS	1,0	3
	Alcis repandata	♂	SiS→HW	1,0	3
1988	*Scotia clavis*	♂	WaN→HO	1,9	2
	Scotia clavis	♂	HM→HO	1,0	2
	Ochropleura plecta	♂	HO→HM	1,0	2
	Noctua pronuba	♂	WaS→WNo	1,4	2
	Noctua pronuba	♂	WaS→WNw	1,3	2
	Amathes triangulum	♂	WaS→WNw	1,3	4
	Rusina ferruginea	♂	HM→HO	1,0	6
	Meristis trigrammica	♂	SiN→WaN	1,4	3
	Hoplodrina alsines	♂	HW→WNo	3,25	5
	Hoplodrina alsines	♂	WaS→HO	1,45	1
	Peribatodes rhomboidaria	♂	WNo→HO	1,9	1

Alle Angaben wurden genauen Prüfungen unterzogen, auch die beiden Wiederfänge nach 1 Tag können als gesichert gelten. Eine Verschleppung mit der Falle durch ungenügende Achtsamkeit beim Absammeln von markierten Faltern, die dort Unterschlupf suchten, konnte in den genannten Fällen durch Markierung der Fallen ausgeschlossen werden: Die Falle des Erstfangs war am Wiederfundort nicht eingesetzt worden. Die Auswertung erfolgte auch in genügendem Abstand zum Fahrzeug, und eine Tasche mit

den nötigen Utensilien wurde nur zur Auswertung, nicht jedoch beim Aufstellen der Falle mitgenommen; auch dadurch können Fehlerquellen bezüglich einer Verschleppung von Faltern ausgeschlossen werden.
In vier Fällen blieben diesbezüglich jedoch Zweifel übrig, die betroffenen Wiederfänge wurden daher nicht berücksichtigt.

8.2.2. Diskussion

Bei der Betrachtung der 13 Wiederfänge, die über Distanzen von mindestens 1 km erfolgten, zeigt sich, daß es sich hier vor allem um Eulenfalter (*Noctuidae*) handelt: Sie stellen 64,1 % aller markierten Individuen, aber 84,6 % der Wiederfänge über größere Distanzen. Auch die beiden Spanner (*Geometridae*) sind große Arten mit relativ starkem Thorax. Die Dispersionsaktivitäten über Distanzen von 1-4 km scheinen also in Korrelation zur mechanischen Flugfähigkeit zu stehen, was jedoch nicht umgekehrt bedeuten muß, daß für jede flugkräftige Art solche Entfernungen zum normalen Dispersal gehören.
SCOTT (1975) stellte in seiner Untersuchung von Tagfalter-Flugaktivitäten fest, daß die meisten Arten die Distanz von mehreren Kilometern nicht bewältigen. Der weiteste nachgewiesene Flug fand über eine Strecke von 2940 m statt. Die Aussagen entsprechen dem im Untersuchungsgebiet für die Nachtfalter Gefundenen.

Bei allen Wiederfängen handelte es sich um Männchen. Die Weibchen-Rate bei den markierten Faltern lag im Bereich von durchschnittlich 27 %. Es handelt sich also auch hier um eine Überrepräsentierung.

Ubiquisten (r-Strategen) sind in der oben aufgeführten Liste verstärkt vertreten: Fallen 9,9 % der im Untersuchungsgebiet festgestellten Gesamtartenzahl in diese Kategorie, so waren 56 % der Arten, bei denen größere Flugdistanzen beobachtet wurden, Ubiquisten. Die Arten des mesophilen Graslandes sind mit 22 % vertreten (15,8 % im Gesamt-Artenspektrum). Stark unterrepräsentiert sind dagegen die Arten der Wälder, der Waldränder und der Gebüschformationen mit 22 % statt 57,9 %. Diese können also als weniger expansiv gelten.

Der Befund, daß die als Wanderfalter bekannte *Noctua pronuba* in relativ kurzen Zeitspannen jeweils von Süd nach Nord flog, ist vermutlich auf ein solches Migrationsverhalten zurückzuführen.

1987 ereigneten sich auffallend wenig Fern-Wiederfänge, nämlich 0,026 % der markierten Falter im Gegensatz zu 0,070 % 1988. Vielleicht spielte hier die etwas feuchtere Witterung (v.a. von April bis Juni) im Jahr 1987 eine Rolle.

Geländestrukturen spielen zumindest in Einzelfällen eine Rolle bei der Ausbreitung: Beide Ortswechsel 1987 erfolgten entlang der auwaldartigen Kanalbegleitflora des Würmkanals. Langgestreckte, schmale Strukturen sind auch nach WATT et al. (1977) ein begünstigender Faktor für Dispersionsaktivitäten. Da auch die 1988 von *Peribatodes rhomboidaria* zurückgelegte Strecke entlang der Luftlinie fast ausschließlich aus Waldrandstrukturen besteht, sind beide Geometriden-Wiederfänge über größere Entfernungen hinweg potentiell durch Geländestrukturen begünstigt worden.

Bei den Fern-Wiederfängen ist kein signifikanter Zusammenhang zwischen Entfernung und Zeitspanne erkennbar. Die betreffenden Arten scheinen also nicht die Summe vieler Tagesdistanzen zur Bewältigung der beobachteten Entfernung zu benötigen.

Aus den Tatsachen, daß bei einem derartigen Umfang der Stichprobe (> 23.800) Wiederfänge über Distanzen von 1-4 km nicht einmal im Promillebereich und ausschließlich von Männchen nachzuweisen waren, ist abzuschätzen, daß hypothetisch neugeschaffene Biotope in einer entsprechenden Entfernung zu stabilen Nachtfalterpopulationen des gleichen Lebensraumtyps nur langsam und unvollständig besiedelt werden können. Eine Vernetzung von Biotopen sollte daher mit Abständen von unter 1 km erfolgen.

Diese Befunde stehen im Einklang mit den von SCOTT (1972) und WATT et al. (1977) publizierten Ergebnissen, die bei nordamerikanischen Tagfaltern schon in einer Entfernung von wenigen 100 m nur wenig Austauschereignisse bzw. eine weitgehende Isolierung von Populationen feststellten.

8.3. VERRINGERTE FALLENDISTANZEN

8.3.1. Übersicht über das Material

Zur Beschreibung des Experiments und des Geländes siehe 8.1.2. und 2.2..
Im Jahr 1988 wurden im Wasserwerksgelände Oberschleißheim 5335 der 11.392 gefangenen Nachtfalter (*Macroheterocera*) markiert. Es erfolgten 159 Wiederfänge. Zu Vergleichszwecken können auch die 1280 im Jahr 1987 markierten Nachtfalter (17 Rückfänge) herangezogen werden.
Aus Abb. 17 werden die 154 im Wasserwerk 1988 nachgewiesenen Ortswiederfänge bzw. Dispersionsaktivitäten ersichtlich. Fünf Rückfänge beziehen sich auf zugeflogene Stücke anderer Fangplätze (siehe 8.2.).

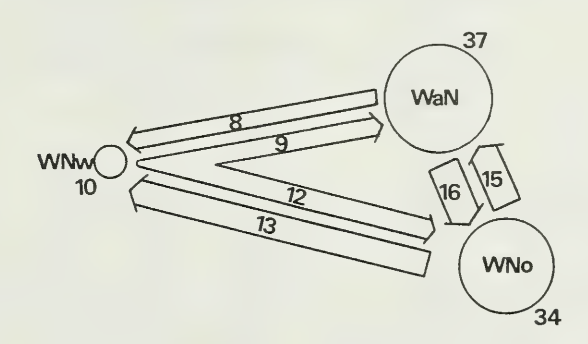


Abb. 17: Ortswiederfänge und Ortswechsler 1988 im Wasserwerk (siehe 2.2.).
Recaptures at the same site and changes of site 1988 in the pump station (see 2.2.).

Es zeigt sich ein deutlicher Abfall der Austauschraten um ca. die Hälfte schon bei einer Verdoppelung der Distanz von 50 m (WaN/WNo) auf 100 m (WaN/WNw). Die Distanz scheint jedoch nicht der einzige die Verbreitung begrenzende Faktor zu sein, da beispielsweise auf der Strecke WNo-WNw (120 m) ein größerer Individuenaustausch stattfand als zwischen WaN und WNw. Hier spielen offensichtlich Geländestrukturen eine Rolle. Hin- und Rückflug zeigen fast identische Werte: Es liegen, insgesamt gesehen, keine konstanten, gerichteten Prozesse vor.

Die durchschnittliche Wiederfang-Quote lag mit 2,9 % deutlich über dem 1987 an WaN festgestellten Wert von 1,3 %. 1988 wurden durch die bessere Abdeckung des Geländes

(3 Fallen) auch die in der Nähe verweilenden Falter miterfaßt, die bei einem Einzelstandort außerhalb der Fallenreichweite geblieben wären.
Dementsprechend verteilten sich auch die Anteile der 1988 festgestellten Wiederfang-Quoten: An WaN entfielen von den 3,0 % beobachteten Wiederfängen 1,8 % auf ortstreue Falter, der Rest stammte von den Nachbarstandorten.
Andersherum betrachtet konnte das Wiederfangergebnis durch die Erhöhung der Fallenzahl von 1,8 % um 1,2 %, die an den anderen Fallen wiedergefunden wurden, auf ebenfalls 3,0 % gesteigert werden.
Am Standort WNw war die geringste Stabilität nachzuweisen, hier lag die Ortswiederfang-Quote mit 0,7 % deutlich unter derjenigen der beiden anderen Fangplätze (WaN und WNo jeweils 1,8 %).

Diese für alle markierten Arten etwas pauschale Skizzierung der Verhältnisse wird in den Tabellen 17 und 18 etwas weiter differenziert: In die Liste wurden die Arten mit aufgenommen, von denen mindestens 100 Individuen markiert wurden und/oder zumindest 5 Wiederfänge vorlagen.

Tab. 17: Die wichtigsten Wiederfänge an den drei Standorten im Wasserwerk 1988, geordnet nach der Wiederfang-Quote.
The most important recaptures of the three capture-sites at the pump station 1988, according to their recapture-rate.

ART *species*	MARKIERT *marked*	WIEDERFÄNGE Σ *recaptures*	WIEDERFANG-QUOTE (%) *percentage of recaptures*
Chiasmia clatrata (I+II)	36	8	22,2
Diacrisia sannio	50	6	12,0
Cerastis rubricosa	83	7	8,4
Mythimna impura	200	15	7,5
Spilosoma menthastri	125	9	7,2
Scotopteryx chenopodiata	326	19	5,8
Orthosia gothica	208	10	4,8
Amathes ditrapezium	124	6	4,8
Alcis repandata	294	9	3,1
Amathes sexstrigata	332	9	2,7
Amathes triangulum	184	5	2,7
Amathes xanthographa	106	2	1,9
Apamea anceps	110	2	1,8
Rusina ferruginea	121	2	1,7
Eilema depressa	336	3	0,9
Ochropleura plecta	380	2	0,5
Amathes c-nigrum	361	1	0,2
Noctua pronuba	185	-	0,0

Es ergibt sich eine mehr oder weniger kontinuierliche Verteilung, deren Gradient abgesehen von einigen Ausnahmen in etwa dem r-K-Kontinuum entsprechen dürfte. So finden sich in der oberen Hälfte der Tabelle signifikant mehr Spanner (*Geometridae*) und Spinner (*Bombyces*), während in der unteren Hälfte mehr Eulenfalter (*Noctuidae*) vertreten sind. Aufgrund unterschiedlicher Raupenfutterpflanzen sind - wie schon im ersten Teil angeklungen ist - bei den Noctuiden mehr r-Strategen zu finden als in den anderen Gruppen. Dementsprechend befinden sich auch die in der Literatur als Wanderfalter bezeichneten *Noctua pronuba* und *Amathes c-nigrum* am Ende der Tabelle.
Zur Problematik der Interpretation von Ortswiederfängen sind einige Aspekte, die in 8.5. näher beleuchtet sind, zu beachten. In der Nähe herumvagabundierende Individuen dürften jedoch zu einem Großteil durch die Erhöhung der Fallenzahl erfaßt worden sein.

Tab. 18: Die wichtigsten Wiederfänge im Wasserwerk 1988, geordnet nach der mittleren Verweildauer.
The most important recaptures at the pump station 1988, according to their mean of residence time.

ART *species*	MITTLERE VERWEILDAUER (Tage) *mean of residence time (days)*	MAXIMAL BEOBACHTETE VERWEILDAUER (Tage) *observed maximum of residence time (days)*	MITTLERE FLUGDISTANZ (Meter) *mean of flight distance (m)*
Cerastis rubricosa	6,33	10	63
Diacrisia sannio	5,33	16	28
Orthosia gothica	5,22	13	59
Chiasmia clatrata	5,00	11	40
Alcis repandata	4,14	7 (3 Exemplare)	13
Mythimna impura	3,92	9 (HO 1987 27 Tage)	57
Scotopteryx chenopodiata	3,83	15	26
Spilosoma menthastri	3,75	8	24
Amathes triangulum	3,20	7 (sonst 3 Tage)	54
Amathes sexstrigata	2,63	5	39
Amathes ditrapezium	2,33	3	33
		Stichproben zu klein	
Apamea anceps	3,50	4	25
Eilema depressa	2,66	3	17
Rusina ferruginea	2,50	3	120
Amathes xanthographa	2,00	2	60
Ochropleura plecta	2,00	2	50
Amathes c-nigrum	2,00	2	0
Noctua pronuba	-	-	-

Die Frühlingsarten (*O. gothica, C. rubricosa*) fallen durch verlängerte Verweildauern auf, ein vermutlich witterungsbedingtes Phänomen. Die eigentlichen Flugnächte liegen hier zwischen Phasen der Unbeweglichkeit bei nicht ganz optimalen Flugbedingungen.

Bei den Arten des "Sommerblocks" erfolgen dagegen offenbar Ortsveränderungen auch unter suboptimalen Voraussetzungen.

Unter der Annahme einer vergleichbaren Mortalität sind "residence time" und "dispersal" zwei negativ korrelierte Parameter (WATT et al., 1977).
Ein signifikanter Anstieg der mittleren Flugdistanzen von oben nach unten (zunehmend starke r-Strategen) in der Tabelle ist nicht zu belegen, da die Flugstrecken der r-Strategen in anderen Größenordnungsbereichen liegen. Bei den beobachteten Flugdistanzen handelt es sich vermutlich um trivial movement; auch die am meisten ortsgebundenen der untersuchten Arten können Strecken von ca. 100 m bewältigen.

Nach systematischen Gruppen aufgeschlüsselt ergibt sich für die Eulenfalter (*Noctuidae*) eine mittlere Flugdistanz von 51 m. Bei den Spannern (*Geometridae*) sind es wie bei den Spinnern (*Bombyces*) 26 m, wenn man nur die Arten mit über 5 Wiederfängen berücksichtigt. Die geringen Artenzahlen bei den Spannern (3) und Spinnern (2) stellen für das Ergebnis jedoch noch Unsicherheitsfaktoren dar. Wenn man die Anzahl der Wiederfänge (51) betrachtet, so stellen diese beiden Gruppen 50 % des Materials, was genügen sollte.

8.3.2. Weitere Ergebnisse, aufgezeigt an ausgewählten Arten

Diacrisia sannio:

Bei Streifzügen durch magere Wiesen entdeckt man oft aufgeschreckte Exemplare dieser Art. Diese fliegen dann normalerweise 5-10 m, höchstens 20 m weit und lassen sich dann wieder im Gras nieder.
An WNw war kein Ortswiederfang festzustellen, an den anderen Standorten je zwei. Der westliche Fangplatz ist auch durch die geringeren Ausbeuten nur als suboptimaler Lebensraum für *D. sannio* charakterisiert. An ungünstigeren Stellen finden vermehrt Austauschprozesse statt.

Ochropleura plecta:

Bei beiden Wiederfängen handelte es sich um ♀♀, die vielleicht beim Kopulations- oder Eiablagegeschehen eine größere Ortsfestigkeit zeigen als die ♂♂.

Amathes ditrapezium:

Ähnlich dem Bärenspinner *Diacrisia sannio*: An WNw schlägt sich die vermutlich durch die Habitatrand-Lage bedingte höhere Dynamik in den fehlenden Ortswiederfängen nieder. 5 der 6 Wiederfänge belegen ein Verbleiben in einem 50 m-Radius des Verbreitungszentrums (WaN/WNo), allerdings bei kurzen Verweildauern.

Amathes sexstrigata:

Ähnlich dem Bärenspinner *Diacrisia sannio* fehlten an WNw Ortswiederfänge, die Ausbeuten waren hier geringer. Dies mag mit erhöhten Austauschprozessen und Dispersionsaktivitäten an den Rändern von (Teil-)Populationen erklärt werden.
8 der 9 Wiederfänge, nämlich die Ortswiederfänge an WaN und WNo sowie die Wechsler zwischen den beiden Standorten, zeugten von einem Verbleiben in einem 50 m-Bereich innerhalb des Verbreitungszentrums.

Cerastis rubricosa:

Trotz der hohen Wiederfang-Quoten und Verweildauern zeigt sich innerhalb des Wasserwerkgeländes eine Dynamik auf relativ hohem Niveau: Es überwiegen hier die Ortswechsler, und bei einem ♂ wurde sogar ein Ortswechsel von WaN→WNw→WNo (220 m) über 8 Tage hinweg mitverfolgt.

Orthosia gothica:

Die hohe Wiederfang-Quote und Verweildauer sollte nicht vorschnell zu einer Charakterisierung dieser Art als K-Strategen führen. Auffallend ist schon die Verteilung der Wiederfänge (siehe auch 9.2.): Ähnlich der vorhergehenden Art überwiegen auch hier die Ortswechsler, Ortswiederfänge erfolgten nur an WaN (3). Bei einigermaßen vergleichbaren Zahlen der markierten Individuen steht den 8 Wiederfängen an WaN kein einziger an WNw gegenüber; an letztgenanntem Standort scheint die Dynamik am höchsten zu liegen.

Da WNw auch am weitesten von der nächstgelegenen Weide, der wohl wichtigsten Nektarquelle von *O. gothica*, entfernt liegt, ist hierin ein Zusammenhang zu vermuten: An Standorten mit blühenden Weiden kommt es zu einer starken Reduktion des trivial movement.

Bei einem ♂ konnte ein Ortswechsel von WNw→WNo→WaN (170 m, 4 Tage) mitverfolgt werden.

Mythimna impura:

Es ist das gleiche Phänomen festzustellen wie bei *Diacrisia sannio, Amathes ditrapezium* und *A. sexstrigata*. Das Verbreitungszentrum ist hier WNo, dort erfolgten wie auch an WaN drei Wiederfänge am selben Ort; an WNw fehlte ein solcher.

Im Gegensatz zu den drei oben genannten Bewohnern von tendenziell trockeneren Wiesen ist *M. impura* eher an Schilf und Seggen gebunden. Dies ist eine denkbare Erklärung für den Sachverhalt, daß in das dynamische Geschehen der Fangplatz WNw stärker miteinbezogen wurde: Dies war in 6 der 15 Wiederfänge der Fall.

Zwei ♂♂ flogen von WNo nach WNw und wieder zurück (240 m). Dies ereignete sich in einer Zeitspanne von 4 bzw. 7 Tagen.

M. impura ist ein schönes Beispiel dafür, daß offensichtlich ortstreuere Arten in Bereichen von ca. 100 m durchaus eine ausgeprägte Dynamik im Sinne eines trivial movement besitzen.

Scotopteryx chenopodiata:

Diese Art reagierte nun etwas verschieden von den bisher besprochenen Mustern: An allen Standorten erfolgten proportional ungefähr gleiche Anteile an Ortswiederfängen. Diese lagen insgesamt mit 13 von 19 auf einem hohen Niveau. Man kann also auch bei so klein gewählten Distanzen von geringen Austauschraten ausgehen!

Die ♀♀ scheinen bei einer mittleren Flugdistanz von 17 m ortsfester zu sein als die ♂♂ (30 m). Die mittlere Verweildauer der ♀♀ liegt jedoch genau im Schnitt.

Chiasmia clathrata:

Wie *Mythimna impura*: Das Verbreitungszentrum liegt an WNo (tagsüber wie in der Nacht!). 6 der 8 Wiederfänge spielten sich an/zwischen WaN und WNo ab. Am westlichen Standort erfolgte kein Ortswiederfang, an dieser Habitatrand-Lage ist also eine höhere Dynamik, verursacht durch geringere Bodenständigkeit zu beobachten. Der hohe Anteil der Ortswiederfänge an den anderen beiden Fangplätzen (5 von 7) kennzeichnet *C. clathrata* ebenfalls als vergleichsweise ortstreue Art.

Die Wiederfang-Quote liegt in der ersten Generation mit 26,3 % deutlich über den 17,6 % der zweiten Generation. Da ein ♂ sehr früh in der 2. Generation zweimal wiedergefangen wurde, kann man ab Mitte Juli von einer spürbar erhöhten Dispersionsaktivität ausgehen.

Alcis repandata:

Bei dieser Art wurde nur ein Ortswechsler bei 9 Wiederfängen festgestellt! Diese eigentlich auf hohe Ortstreue hinweisende Beobachtung steht etwas im Gegensatz zu den oft nur kurzen Verweildauern von 2 Tagen. Berücksichtigt man auch die niedrigeren Fang- und Wiederfangzahlen an WaN, so ist zu vermuten, daß viele Exemplare von den Waldrändern herbeigeflogen waren und an WNo und WNw, die diesen Rändern näher liegen, vielleicht ein mehrfaches Hin- und Herfliegen erfolgte.
Die ♀♀ sind im Wiederfang (11 %) gegenüber den Erstfängen (34 %) unterrepräsentiert.

8.4. VERSETZEXPERIMENT

8.4.1. Übersicht über das Material

Die Zahl der 1988 im Garten (WaS) im Rahmen des Versetzexperiments (ausgewählte Arten) markierten Individuen betrug 2465, es wurden 475 Wiederfänge verzeichnet.
Im Torfeinfang (We) wurden 1988 629 Spanner der Art *Calospilos sylvata* markiert, von denen 46 rückgefangen werden konnten.

Da - wie bereits erwähnt - auch Ortswechsler zwischen SiN und WaS (30 m) als "versetzte" Nachtfalter interpretiert werden können (wenn nicht eine präferenzielle Rückkehr vorliegt, vergleiche KELLER, MATTONI & SEIGER, 1966), ist eine Betrachtung der zwischen diesen beiden Fangplätzen stattfindenden Austauschraten interessant:

- **1987** waren die Ortswiederfang-Quoten an SiN und WaS (bei fangfreien Nächten dazwischen) mit 1,5 % bzw. 1,2 % ungefähr gleich. In 30 m Entfernung waren bei einer Richtung SiN→WaS nach einem Intervall von 1 Tag weitere 0,4 %, insgesamt weitere 1,0 % wiederzufangen. Umgekehrt betrugen die Werte 0,6 % und 1,0 %.
- **1988** zeigte sich an SiN bei gleicher Methode eine entsprechende Ortswiederfang-Quote von 1,2 %, der nach WaS abwandernde Prozentsatz fiel mit 1,5 % etwas höher aus, da dort über einen Großteil der Flugzeit hinweg täglich geleuchtet wurde und die Erfassung somit vollständiger erfolgte. Durch diesen veränderten Rhythmus stiegen auch die Ortswiederfänge an WaS drastisch auf 21,5 %, während der Anteil der von WaS nach SiN fliegenden Tiere mit 0,9 % ungefähr gleich blieb.
  Die Berechnungen wurden durch Abzug der im eigentlichen Versetzexperiment gesammelten Daten bereinigt.
- Bei einem **Vergleich mit dem Wasserwerk** zeigt sich, daß der Individuen-Austausch zwischen den Fallen beispielsweise im Vergleich mit dem Fallenpaar WaN/WNo bei einer etwas kleineren Distanz ungefähr proportional höher ausfiel: Dividiert man die Summe der ausgetauschten Individuen durch die Summe der an beiden Standorten markierten Falter ergeben sich für den Garten (1987) 1,0 %, für das Wasserwerk (1988, WaN/WNo) 0,8 % ausgetauschter Nachtfalter. Es handelt sich hierbei wohlgemerkt um keine Absolutzahlen, die realen Austauschraten liegen sicherlich höher.
  Die Barriere der Häuserzeile scheint demnach zusammen mit den anderen Störeinflüssen (Straßenbeleuchtung u.s.w.) kein Hindernis darzustellen, das sich wesentlich von der Geländestruktur im Wasserwerk, nämlich einer relativ naturnahen halbverbuschten Fläche unterscheidet.
  Diese Aussage muß aber, da sie über eine gemeinsame Betrachtung aller markierten Arten getroffen wurde, nicht für alle Arten gleichermaßen zutreffen.

8.4.2. Ergebnisse

Scotia clavis:

Tab. 19-21: Ausbeute, Markierungen und Wiederfänge im Garten 1988 bei Scotia clavis.
Numbers of individuals, marked specimens and recaptures of Scotia clavis in the garden 1988.

	Ausbeute (Individuen)			Markierungen			Wiederfänge/Mehrfachwiederfänge								
	SiN	WaS	Σ	SiN	WaS	Σ	W.f. 1	2	3	4	5	6	7	8	Σ
♂♂	25	158	183	23	119	142	26	6	5	1	-	-	-	-	38
♀♀	2	20	22	2	18	20	2	-	-	-	-	-	-	-	2
Σ	27	178	205	25	137	162	28	6	5	1	-	-	-	-	40
Par.	27	62													

In Tabelle 19 ist eine Erhöhung der Werte durch die hier mitgezählten Wiederfänge zu veranschlagen, eine Bereinigung der Angaben wird durch Tab 21 möglich.

Unter "Par." ist in der Tabelle 19 das aus den Parallelfang-Ergebnissen stammende direkt vergleichbare Individuenverhältnis aufgeführt. Gelegentlich auftretende Differenzen zu den in der Artenliste (4. Kapitel) angegebenen Zahlen entstehen durch entkommene Exemplare, deren Artbestimmung erfolgte, nicht aber die Geschlechtsbestimmung.

Die Weibchen-Rate ist an WaS fast doppelt so hoch wie an SiN. Im Wiederfang sind die ♀♀ mit 5 % etwas unterrepräsentiert.

Tab. 22: Zwischen Fang und Wiederfang festgestellte Intervalle bei *Scotia clavis* 1988 im Garten.
Intervals (in days) between two catches of Scotia clavis 1988 in the garden.

Intervall (Tage)	1	2	3	4	5	6	7	8	9	10	11	12	Σ
Wiederfänge	35	5	-	-	-	-	-	-	-	-	-	-	40

Das Intervall zwischen Fang und Wiederfang beträgt im Mittel 1,13 Tage.
Die Tabelle 22 offenbart bereits eine hohe Dynamik von *Scotia clavis* an diesem Standort, die kurzen Verweildauern, wie sie aus den Abbildungen 18 und 19 ersichtlich sind, können nicht allein auf Mortalität zurückzuführen sein.

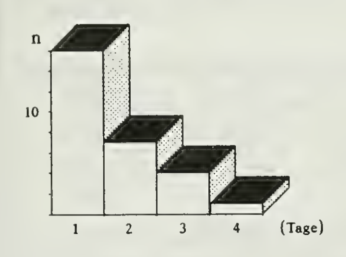


Abb. 18: Apparente Verweilzeiten von *Scotia clavis* 1988 im Garten.
Apparent residence times of Scotia clavis 1988 in the garden.

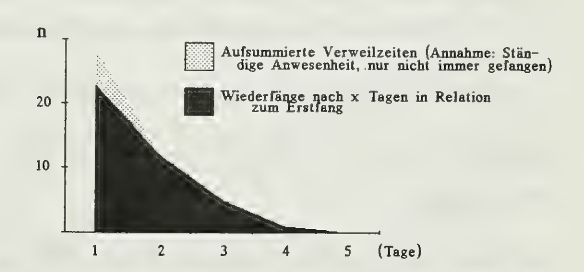


Abb. 19: Aufsummierte Verweilzeiten und real nach x Tagen beobachtete Wiederfänge.
Accumulated residence times and really after the time x recaptured specimens.

Die durchschnittliche Verweilzeit, errechnet aus den Wiederfängen, betrug nur 1,57 Tage. Nicht berücksichtigt bleiben die Individuen, von denen keine Wiederfänge vorliegen. Es handelt sich daher um einen relativen Wert.
Auch die Verlustkurven in Abb. 19 zeugen von einem schnellen Verschwinden aus dem Einzugsbereich der Falle.

Tab. 23: Reaktion von *Scotia clavis* auf ein Versetzen in verschiedene Entfernungen.
Recaptures of specimens of Scotia clavis, released at different distances from the light source.

	0 m	30 m	60 m	90 m	120 m
freigelassen* *released*	95	22	20	25	12
Wiederfänge *recaptures*	25	4	3	3	1
%	26	18	15	12	8

* Summe aus markierten Faltern und einigen freigelassenen Wiederfängen.

Das Versetzexperiment zeigt einen kontinuierlichen Abfall der Wiederfang-Wahrscheinlichkeit mit zunehmender Versetzdistanz. Dies ist vermutlich auf ein zickzackartiges, mehr oder weniger ungerichtetes Umherschweifen in der weiteren Umgebung zurückzuführen (siehe Peribatodes rhomboidaria). Ausgeprägte und zielgerichtete Dynamiken würden zu einem stärkeren Abfall der Werte bei 90 und 120 m führen (siehe Noctua pronuba).
Eine Verlängerung der Rückkehrdauer mit zunehmender Versetzdistanz war nicht zu beobachten. Distanzen bis 120 m scheinen also im Bereich des trivial movement einer Nacht zu liegen.

Scotia exclamationis:

Die Stichprobengröße bei *Scotia exclamationis* 1988 im Garten ist relativ klein (98 markierte, 14 wiedergefangene Falter). Der starke Abfall von 11 Erst- auf 3 Zweitwiederfänge entspricht ungefähr den Verhältnissen bei *S. clavis*.
Die Weibchen-Rate liegt auch hier an WaS deutlich höher als an SiN. Im Wiederfang sind die ♀♀ jedoch mit 64 % deutlich überrepräsentiert! Im Gegensatz zu *S. clavis* scheinen bei *S. exclamationis* die ♂♂ mobiler zu sein. Die ♀♀ stellen auch alle beobachteten Zweitwiederfänge.

Tab. 24: Zwischen Fang und Wiederfang festgestellte Intervalle bei *Scotia exclamationis* 1988 im Garten.
Intervals (in days) between two catches of Scotia exclamationis 1988 in the garden.

Intervall (Tage)	1	2	3	4	5	6	7	8	9	10	11	12	Σ
Wiederfänge	12	-	1	-	1	-	-	-	-	-	-	-	14

Das Intervall zwischen Fang und Wiederfang beträgt im Mittel 1,43 Tage.
Die mittlere Verweildauer liegt bei 1,73 Tagen, ein Unterschied zwischen den Geschlechtern ist nicht ersichtlich.
Die Wiederfang-Quote der an der Falle freigelassenen Tiere entspricht mit 23 % in etwa dem Wert von *Scotia clavis* (n=53). Von den in den verschiedenen Entfernungen

ausgesetzten Faltern (n=26) konnte nur ein ♂ aus 60 m zurückgefangen werden. Die Stichprobengröße ist hierbei noch zu klein, um nähere Rückschlüsse zu erlauben.

Noctua pronuba:

Als bekannter Wanderfalter sollte *Noctua pronuba* - wie es bei einer hochmobilen Art zu erwarten ist - mit kurzen Verweildauern und sehr niedrigen Rückfang-Quoten bei einem Versetzen um 90 bzw. 120 m reagieren. Letzteres deshalb, weil hier bei geradlinigen starken Flugaktivitäten Individuen, die nicht die Richtung der Lichtquelle einschlagen (Winkel von ca. 330-340° = 92-94 % unter der Voraussetzung einer freien Beweglichkeit ohne Barrieren) auf Nimmerwiedersehen verschwinden.
Bei einem Herumvagabundieren mit häufigeren Richtungswechseln kommt es dagegen zu einer erhöhten Wiederfangwahrscheinlichkeit auch bei größeren Versetzdistanzen. Dies ist jedoch bei manchen Arten auch durch eine "Kanalisierung" des Fluges durch die Biotopgrenzen im Waldstreifen denkbar. Die Unterschiede zu den Biotopstrukturen der umliegenden Gärten sind jedoch nicht besonders gravierend.

Ein Vergleich mit einem ähnlichen Experiment an *Spodoptera littoralis* in Israel (PLAUT, 1971), ebenfalls einem Wanderfalter, ist hier möglich.

Tab. 25-27: Ausbeute, Markierungen und Wiederfänge im Garten 1988 bei Noctua pronuba.
Numbers of individuals, marked specimens and recaptures of Noctua pronuba in the garden 1988.

	Ausbeute (Individuen)			Markierungen			Wiederfänge/Mehrfachwiederfänge								
	SiN	WaS	Σ	SiN	WaS	Σ	W.f. 1	2	3	4	5	6	7	8	Σ
♂♂	26	492	518	26	400	426	57	17	8	3	2	1	1	-	89
♀♀	14	433	442	14	355	369	50	19	4	-	-	-	-	-	73
Σ	48	1011	1059	40	755	795	107	36	12	3	2	1	1	-	162
Par.	48	448													

In Tabelle 25 ist eine Erhöhung der Werte durch die hier mitgezählten Wiederfänge zu veranschlagen, eine Bereinigung der Angaben wird durch Tab 27 möglich.
Die Weibchen-Raten liegen an SiN (35 %) und WaS (47 %) auf ähnlich hohem Niveau (NOVAK, 1974: 19 %), in den Wiederfängen zeigen sich die gleichen Verhältnisse.
Die proterandrische Phänologie kommt in Abbildung 20 gut zum Ausdruck. Sie steht im Gegensatz zu dem von MEINEKE (1984) im südlichen Niedersachsen festgestellten Befund. Nach NOVAK (l.c.) ist *N. pronuba* weder proterandrisch noch protogyn.

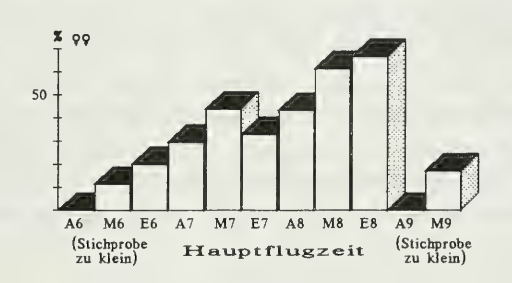


Abb. 20: Ansteigen der Weibchen-Rate (Proterandrie) im Lauf der Flugzeit bei *Noctua pronuba* im Garten 1988.
Increase of sex-ratio of Noctua pronuba in the garden 1988.

Tab. 28: Zwischen Fang und Wiederfang festgestellte Intervalle bei *Noctua pronuba* 1988 im Garten.
Intervals (in days) between two catches of Noctua pronuba 1988 in the garden.

Intervall (Tage)	1	2	3	4	5	6	7	8	9	10	11	12	Σ
Wiederfänge	141	16	1	1	2	–	–	–	1	–	–	–	162

Das Intervall zwischen Fang und Wiederfang beträgt im Mittel 1,23 Tage.
Einige der nach einem 2-Tages-Intervall wiedergefangenen Tiere könnten sich in der dazwischenliegenden Nacht in der Nähe der Falle versteckt haben und übersehen worden sein. Die hohe Zahl der Wiederfänge täuscht also darüber hinweg, wie das Ergebnis richtig zu interpretieren ist: Der Anteil an Wiederfängen, die man nicht auf ein Festgehalten-Werden im Bann des Lichts zurückführen kann, liegt unter 1 %!
Aus Abbildung 21 errechnet sich eine mittlere Verweilzeit von 1,88 Tagen. Der Wert der ♂♂ liegt mit 1,93 Tagen etwas über dem der ♀♀ (1,82 Tage). Die genannten Zahlen sind in Vergleichen (z.B. mit *Scotia clavis*) wohl zum großen Teil Ausdruck der anziehenden Wirkung des Lichts, durch das der Aufenthalt in der Nähe der Lichtquelle hinausgezögert wird. *Noctua pronuba* verweilt unter natürlichen Verhältnissen deutlich kürzer in Flächenausschnitten, die dem Einzugsbereich der Lichtfalle entsprechen.

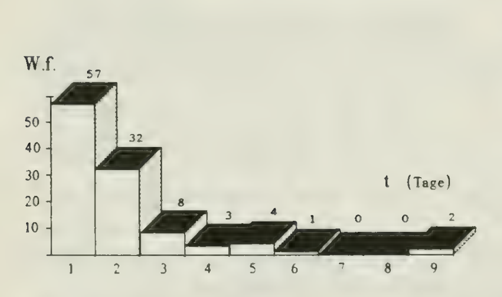
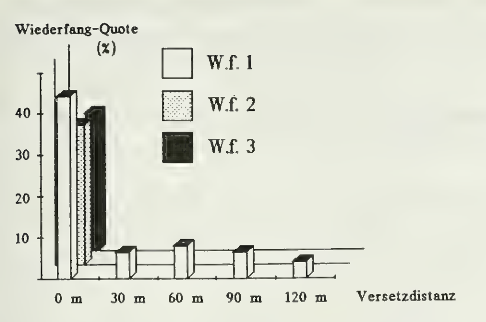


Abb. 21: Apparente Verweilzeiten von Noctua pronuba 1988 im Garten.
Apparent residence times of Noctua pronuba 1988 in the garden.

Aufsummierte Verweilzeiten (Annahme: Ständige Anwesenheit, nur nicht gefangen)
Wiederfänge nach x Tagen in Relation zum Erstfang

Abb. 22: Aufsummierte Verweilzeiten und real nach x Tagen beobachtete Wiederfänge.
Accumulated residence times and really after the time x recaptured specimens.

Die weitgehende Übereinstimmung der beiden Kurven in Abbildung 22 ist auf die besonders große Affinität zum Licht bei dieser Art zurückzuführen. Differenzen, die bei anderen Arten durchaus auftreten können (siehe *Alcis repandata*), können zwei Ursachen haben: Entweder ist die anziehende Wirkung des Lichtes nicht besonders groß und viele in der näheren Umgebung verbleibende Falter werden in den Fangintervallen nicht erfaßt, oder die Individuen bewegen sich in einer Art Zickzackflug und können so nach mehreren Tagen der Abwesenheit wieder in den Einzugsbereich der Lichtquelle zurückkehren.



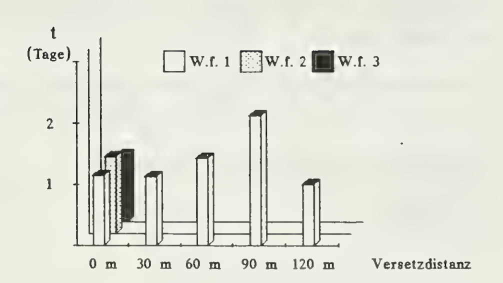


Abb. 23: Wiederfang-Quoten von *Noctua pronuba* im Versetzexperiment.
Probability of recapture of Noctua pronuba, released at different distances.

Abb. 24: Korrelation: Rückkehrdauer und Versetzdistanz.
Correlation of distance of displacement and time, needed for return.

Schon in einer Entfernung von 30 m ist ein starker Rückgang der Wiederfang-Wahrscheinlichkeit festzustellen. Hier nimmt der direkte Lichteinfluß ab und von den versetzten Individuen wird nur der Anteil in den "Lichttrichter" wiedereingefangen, der zufällig die entsprechende Richtung einschlägt. Daher kommt es mit abnehmendem Winkel zu einem leichten Abfall zwischen 30 und 120 m.
Zwischen der Rückkehrdauer und der Versetzdistanz ist keine eindeutige Korrelation festzustellen, ein Befund, der für diesen Wanderfalter zu erwarten war, da es bei der Bewältigung einer Distanz von 120 m zu keinen Schwierigkeiten kommen dürfte.

Äußerst ähnliche Ergebnisse liegen von einem anderen Wanderfalter (*Spodoptera littoralis*) in einer ganz anderen Gegend (Israel) vor: PLAUT (1971) berichtet ebenfalls von einem starken Rückgang der Wiederfang-Wahrscheinlichkeit schon zwischen der ersten und der zweiten Nacht nach dem Markieren sowie zwischen Versetzdistanzen von 10-50 m. Die Ergebnisse scheinen also reproduzierbar zu sein.

Amathes c-nigrum:

Bei dieser Art erfolgte das Versetzexperiment nur in einer Serie von 5 aufeinanderfolgenden Nächten. Die zu kleine Stichprobengröße läßt daher noch keine statistisch untermauerten Rückschlüsse zu.

Die Verteilung der Erst- und Zweitwiederfänge (47/5) zeugt von einer starken Dynamik. Beim Wanderfalter *Noctua pronuba* und bei *Scotia clavis* waren die Mehrfachwiederfänge stärker repräsentiert, was aber teilweise durch eine größere Affinität zu Licht bedingt sein könnte.

Abgesehen von einem nach 4 Tagen zurückgefangenen ♂ ereigneten sich alle Wiederfänge nach 1- oder 2-Tages-Intervallen.
Auch die mittlere Verweilzeit von nur 1,21 Tagen belegt die hohe Mobilität von *Amathes c-nigrum.*

Tab. 29: Reaktion von *Amathes c-nigrum* auf ein Versetzen in verschiedene Entfernungen. *Recaptures of specimens of Amathes c-nigrum, released at different distances from the light source.*

	0 m	30 m	60 m	90 m	120 m
freigelassen *released*	239	12	20	17	18
Wiederfänge *recaptures*	50	2	-	-	-
%	21	17	-	-	-

Ein vergleichbares 30 m-Experiment stellen die 38 an SiN markierten Tiere dar, von denen keines wiedergefangen wurde. Auch umgekehrt konnte von den 237 an WaS freigelassenen Faltern keiner an SiN nachgewiesen werden. Ähnlich wie bei *Noctua pronuba* sinken auch bei dieser wanderverdächtigen Art die Wiederfang-Quoten drastisch ab, sobald sich die Lichtquelle außer Sichtweite befindet.

Rusina ferruginea:

Bezüglich der Stichprobengröße gilt hier das gleiche wie für die vorige Art.
Bei *Rusina ferruginea* fehlen Zweitwiederfänge gänzlich, und abgesehen von einem ♀, das in 3 Tagen von WaS (0 m) nach SiN flog erfolgten alle Wiederfänge nach einem Tag und sind durch die Methode bedingt. Die mittlere Verweilzeit liegt dementsprechend auf einem sehr niedrigen Niveau von 1,13 Tagen.

Tab. 30: Reaktion von *Rusina ferruginea* auf ein Versetzen in verschiedene Entfernungen. *Recaptures of specimens of Rusina ferruginea, released at different distances from the light source.*

	0 m	30 m	60 m	90 m	120 m
freigelassen *released*	49	10	8	9	7
Wiederfänge *recaptures*	10	1	-	3	-
%	20	10	-	33	-

Es wäre natürlich Unsinn, *Rusina ferruginea* aufgrund der oben erwähnten kurzen Verweilzeiten als Wanderfalter zu bezeichnen, sicherlich nicht falsch ist dagegen die Konstatierung einer hohen Dynamik und Dispersionsaktivität bei dieser Art.

Meristis trigrammica:

Tab. 31-33: Ausbeute, Markierungen und Wiederfänge im Garten 1988 bei *Meristis trigrammica.*

Numbers of individuals, marked specimens and recaptures of Meristis trigrammica in the garden 1988.

	Ausbeute (Individuen)			Markierungen			Wiederfänge/Mehrfachwiederfänge								
	SiN	WaS	Σ	SiN	WaS	Σ	W.f. 1	2	3	4	5	6	7	8	Σ
♂♂	27	120	147	22	66	88	33	12	8	4	1	-	-	-	58
♀♀	1	5	6	1	5	6	-	-	-	-	-	-	-	-	-
Σ	28	125	153	23	71	94	33	12	8	4	1	-	-	-	58
Par.	27	30													

In Tabelle 31 ist eine Erhöhung der Werte durch die hier mitgezählten Wiederfänge zu veranschlagen, eine Bereinigung der Angaben wird durch Tabelle 33 möglich.
Drei Erstwiederfänge und ein Drittwiederfang erfolgten am Fangplatz SiN.
Die Weibchen sind im Wiederfangergebnis unterrepräsentiert, was aber nicht unbedingt auf höhere Mobilität hindeutet, sondern auch durch das schlechtere Anflugverhalten in Verbindung mit den dadurch bedingten statistischen Störeinflussen erklärt werden kann.

Tab. 34: Zwischen Fang und Wiederfang festgestellte Intervalle bei *Meristis trigrammica* 1988 im Garten.

Intervals (in days) between two catches of Meristis trigrammica 1988 in the garden.

Intervall (Tage)	1	2	3	4	5	6	7	8	9	10	11	12	Σ
Wiederfänge	39	8	8	1	-	-	-	1	1	-	-	-	58

Das Intervall zwischen Fang und Wiederfang beträgt im Mittel 1,72 Tage.
Im Gegensatz zu den bisher besprochenen Arten zeigt sich hier ein deutlich erhöhter Anteil der Wiederfänge mit dazwischenliegenden Intervallen, was als Hinweis auf verstärktes Verbleiben in der näheren Umgebung zu deuten ist.

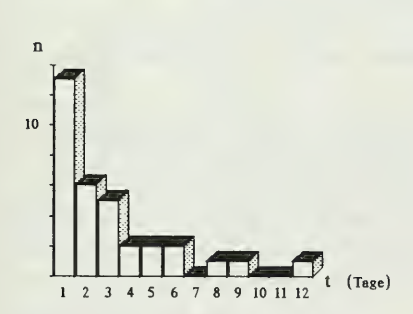


Abb. 25: Apparente Verweilzeiten von *Meristis trigrammica* 1988 im Garten.
Apparent residence times of Meristis trigrammica 1988 in the garden.

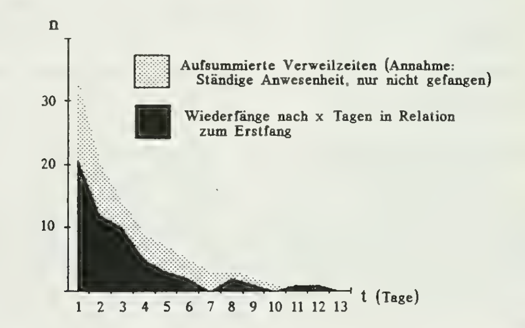


Abb. 26: Aufsummierte Verweilzeiten und real nach x Tagen beobachtete Wiederfänge.
Accumulated residence times and really after the time x recaptured specimens.

Sowohl die hohe durchschnittliche Verweildauer von 3,00 Tagen als auch die deutliche Differenz der Kurven in Abbildung 26 (siehe Bemerkungen zu *Noctua pronuba*) verdeutlichen, daß *Meristis trigrammica* im Rahmen des trivial movement zumindest im Bereich des Gartens relativ ortstreu bleibt.

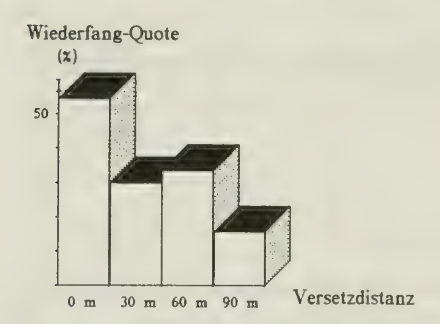


Abb. 27: Wiederfang-Quoten von *Meristis trigrammica* im Versetzexperiment.
Probability of recapture of Meristis trigrammica, released at different distances.

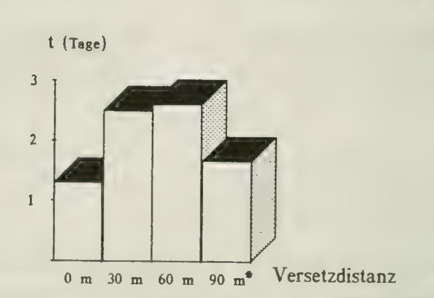


Abb. 28: Korrelation: Rückkehrdauer und Versetzdistanz (* n=3)
Correlation of distance of displacement and time, needed for return.
** only three recaptures*

In der Entfernung von 120 m wurde nur ein ♂ freigelassen, das nicht mehr zurückkehrte. Vom 30 m entfernten Fangplatz SiN, wo 23 Individuen markiert wurden, flogen 3 (13 %) nach WaS, was für eine Barrierewirkung der Häuserzeile spricht. Umgekehrt waren es nur 5,6 %, z.T. wohl aber durch den 2tägigen Fangrhythmus an SiN bedingt. Die Darstellung (Abb. 27) erfolgte unter Hinzunahme der Mehrfach-Wiederfänge, da einige Wiederfänge auch an den Versetzdistanzen freigelassen wurden.

In kühlen Nächten unternehmen die Tiere keine weiteren Flüge: Zwischen dem 4.6. und dem 7.6.1988 beispielsweise flogen bei naßkaltem Wetter nach zwei Tagen 100 %, nach drei Tagen noch 50 % der am 4.6. markierten Falter die Falle an.

Hoplodrina alsines:

Tab. 35-37: Ausbeute, Markierungen und Wiederfänge im Garten 1988 bei *Hoplodrina alsines*.
Numbers of individuals, marked specimens and recaptures of Hoplodrina alsines in the garden 1988.

	Ausbeute (Individuen)			Markierungen			Wiederfänge/Mehrfachwiederfänge								
	SiN	WaS	Σ	SiN	WaS	Σ	W.f. 1	2	3	4	5	6	7	8	Σ
♂♂	23	216	239	21	186	207	24	5	1	-	-	-	-	-	30
♀♀	1	26	27	1	25	26	1	-	-	-	-	-	-	-	1
Σ	24	242	266	22	211	233	25	5	1	-	-	-	-	-	31
Par.	24	69													

Ein Wiederfang stellt einen Ortswechsler (WaS→SiN) dar, sonst handelt es sich ausschließlich um an WaS gemachte Beobachtungen.

Tab. 38: Zwischen Fang und Wiederfang festgestellte Intervalle bei *Hoplodrina alsines* 1988 im Garten.
Intervals (in days) between two catches of Hoplodrina alsines 1988 in the garden.

Intervall (Tage)	1	2	3	4	5	6	7	8	9	10	11	12	Σ
Wiederfänge	21	4	2	2	1	–	–	1	–	–	–	–	31

Das Intervall zwischen Fang und Wiederfang beträgt im Mittel 1,81 Tage.

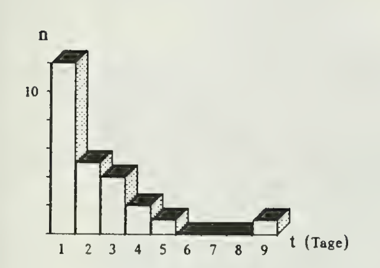


Abb. 29: Apparente Verweilzeiten von *Hoplodrina alsines* 1988 im Garten.
Apparent residence times of Hoplodrina alsines 1988 in the garden.

Aufsummierte Verweilzeiten (Annahme: Ständige Anwesenheit, nur nicht gefangen)
Wiederfänge nach x Tagen in Relation zum Erstfang

Abb. 30: Aufsummierte Verweilzeiten und real nach x Tagen beobachtete Wiederfänge.
Accumulated residence times and really after the time x recaptured specimens.

Die durchschnittliche Verweildauer beträgt 2,24 Tage, das einzige rückgefangene Weibchen flog die Falle nach 4 Tagen zum zweiten Mal an.
Die beobachteten Intervalle und Verlustkurven deuten auf eine Ortstreue hin, die nicht ganz so ausgeprägt ist wie bei *Meristis trigrammica*, jedoch deutlich höher als beispielsweise bei *Noctua pronuba* oder *Amathes c-nigrum*.

Tab. 39: Reaktion von Hoplodrina alsines auf ein Versetzen in verschiedene Entfernungen.
Recaptures of specimens of Hoplodrina alsines, released at different distances from the light source.

	0 m	30 m	60 m	90 m	120 m
freigelassen *released*	135	15	29	24	37
Wiederfänge *recaptures*	24	–	2	1	3
%	18	–	7	4	8

Anders als bei *Meristis trigrammica* zeigt sich hier ähnlich wie bei *Noctua pronuba* ein Knick der Kurve bei 30 m. Es ist keine Korrelation zwischen Rückkehrdauer und Versetzdistanz erkennbar.

Xanthorhoe ferrugata:

Wegen des starken Anfluges im Jahr 1988 mußte bei dieser Art das Versetzexperiment abgebrochen werden, das Arbeitspensum wäre sonst nicht mehr zu bewältigen gewesen.

So wurden nur 5 Individuen dieser Art bei 30 m, 3 bei 60 m und 2 bei 90 m freigelassen. Von diesen markierten Faltern konnte keiner wiedergefangen werden.

Calospilos sylvata:

Diese Spannerart wurde 1988 am Fangplatz "We" im Dachauer Moos näher untersucht. Zur Hauptflugzeit wurde 5 Fangnächte lang im 3-Tage-Rhythmus gefangen. Auf 629 markierte Falter kamen hierbei 46 Wiederfänge, die sämtlich an der Fangstelle freigelassen wurden. Einige Falter wurden dagegen in je 100 m Entfernung an verschiedene Stellen gebracht um den Einfluß von Geländestrukturen auf die Rückkehr-Wahrscheinlichkeit zu testen. Hierzu wurden ein Waldweg, eine Weidenhecke und eine Wirtschaftswiese ausgewählt.
Calospilos sylvata verweilt sehr lange am selben Standort, wie aus Abbildung 31 ersichtlich wird:

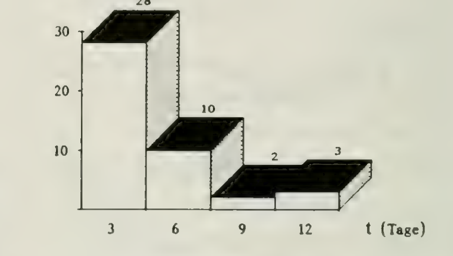


Abb. 31: Apparente Verweilzeiten von *Calospilos sylvata* im Dachauer Moos 1988.
Apparent residence times of Calospilos sylvata in the "Dachauer Moos" 1988.

Aus den Verweildauern der Wiederfänge errechnet sich ein Durchschnittswert von 4,6 Tagen.

Tab. 40: Reaktion von Calospilos sylvata auf ein Versetzen an verschiedene Stellen.
Recaptures of specimens of Calospilos sylvata, released at different places.

	0 m	100 m Hecke *hedge*	100 m Wald *wood*	100 m Wirtschaftswiese *meadow*
freigelassen *released*	342 + 46	147	90	50
Wiederfänge *recaptures*	35	6	5	-
%	9	4	6	-

Ein Ortswiederfang-Ergebnis von 9 % nach **zwei** fangfreien Nächten ist als sehr hoch einzustufen!
Zwischen zwei definierten Punkten scheint ein Individuenaustausch dann am meisten begünstigt zu sein, wenn die dazwischenliegende Strecke waldartig strukturiert ist.
Im Offenland (Wirtschaftswiese) ist jedoch vermutlich eine höhere Mortalität durch Freßfeinde zu veranschlagen.



Abb. 31b: Calospilos sylvata ♂ (We, 4.7.88)



Abb. 31c: Peribatodes rhomboidaria ♂ (WaS, 26.7.88)

Peribatodes rhomboidaria:

Tab. 41–43: Ausbeute, Markierungen und Wiederfänge im Garten 1988 bei *Peribatodes rhomboidaria.*
Numbers of individuals, marked specimens and recaptures of Peribatodes rhomboidaria in the garden 1988.

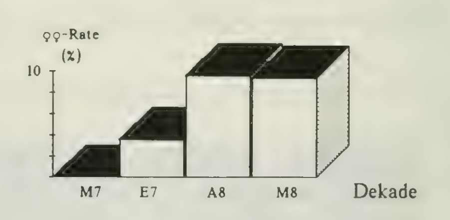
Ausbeute (Individuen)			
	SiN	WaS	Σ
♂♂	23	319	342
♀♀	5	21	26
entkommen	3	34	37
Σ	31	374	405
Par.	31	154	

Markierungen			
	SiN	WaS	Σ
♂♂	18	267	285
♀♀	5	21	26
Σ	23	288	311

Wiederfänge/Mehrfachwiederfänge								
W.f. 1	2	3	4	5	6	7	8	Σ
44	8	1	–	–	–	–	–	53
–	–	–	–	–	–	–	–	–
44	8	1	–	–	–	–	–	53

Die Weibchen-Rate ist an SiN (17,9 %) mehr als doppelt so hoch als an WaS (7,2 %). Die ♀♀ sind im Wiederfangergebnis unterrepräsentiert, was auch hier durch nicht optimales Anflugverhalten und damit verbundene Störungen der statistischen Vergleichbarkeit zu erklären ist.
Abbildung 32 verdeutlicht das proterandrische Erscheinungsbild dieser Art:

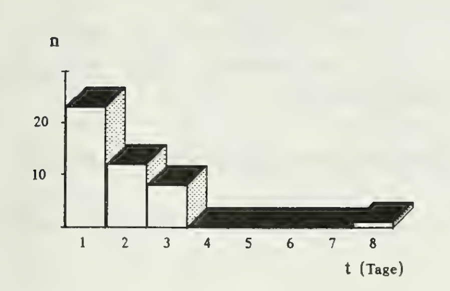
Abb. 32: Ansteigen der Weibchen-Rate (Proterandrie) im Lauf der Flugzeit bei *Peribatodes rhomboidaria* im Garten 1988.
Increase of sex-ratio of Peribatodes rhomboidaria in the garden 1988.



Tab. 44: Zwischen Fang und Wiederfang festgestellte Intervalle bei *Peribatodes rhomboidaria* 1988 im Garten.
Intervals (in days) between two catches of Peribatodes rhomboidaria 1988 in the garden.

Intervall (Tage)	1	2	3	4	5	6	7	8	9	10	11	12	Σ
Wiederfänge	35	11	6	–	1	–	–	–	–	–	–	–	53

Das Intervall zwischen Fang und Wiederfang beträgt im Mittel 1,51 Tage.



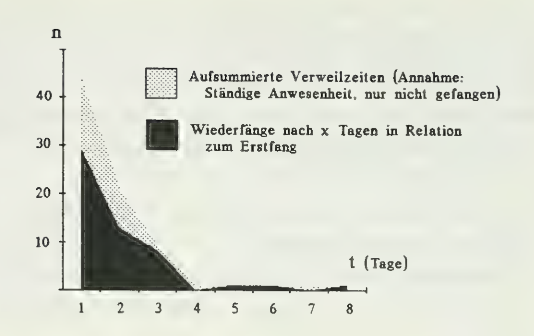
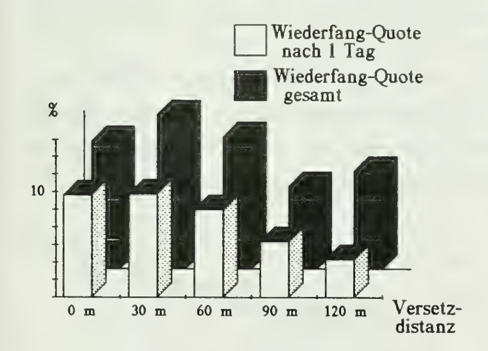


Abb. 33: Apparente Verweilzeiten von *Peribatodes rhomboidaria* 1988 im Garten.
Apparent residence times of Peribatodes rhomboidaria 1988 in the garden.

Abb. 34: Aufsummierte Verweilzeiten und real nach x Tagen beobachtete Wiederfänge.
Accumulated residence times and really after the time x recaptured specimens.

Die mittlere Verweildauer liegt mit 1,80 Tagen unter dem Wert von *Noctua pronuba.* Dies verdeutlicht die Notwendigkeit einer vorsichtigen Interpretation solcher Einzelinformationen. Erst in Verbindung mit zusätzlichen Ergebnissen kann sich dann ein vollständigeres Bild der Populationsdynamik ergeben. Im vorliegenden Fall könnte es durch eine im Vergleich mit *Noctua pronuba* geringere Affinität ans Licht zu einem weniger ausgeprägten "Festhaltephänomen" durch die direkte Lichtwirkung gekommen sein. Die Vergleichbarkeit leidet auch unter den nicht exakt gleich verteilten Individuenzahlen an den verschiedenen Versetzdistanzen. Da bei *P. rhomboidaria* (im Gegensatz zu *N. pronuba*) überproportional viele Tiere direkt an der Falle freigesetzt wurden, könnte es zu einer Überbetonung der 1-Tage-Wiederfänge und einer methodisch bedingten Verringerung der apparenten Verweildauern gekommen sein (siehe *Alcis repandata*).
Die Differenz der beiden Kurven in Abbildung 34 ist jedoch ein Hinweis auf weniger dynamische Prozesse als bei den hochmobilen Arten wie *Amathes c-nigrum* oder *Noctua pronuba.*



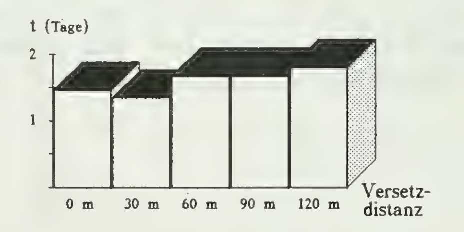


Abb. 35: Wiederfang-Quoten von *Peribatodes rhomboidaria* im Versetzexperiment.
Probability of recapture of Peribatodes rhomboidaria, released at different distances.

Abb. 36: Korrelation: Rückkehrdauer und Versetzdistanz.
Correlation of distance of displacement and time, needed for return.

Von den Wiederfängen (Distanz: 0 m) wurden am 1. Tag 11,8 %, und insgesamt 17,6 % ein weiteres Mal gefangen. Dies entspricht dem Wert für die Erstfänge.

Bei einer gemäß den Ausführungen in 8.1.3. über die parallel laufenden 0 m-Werte durchgeführten Bereinigung der Wiederfang-Quoten ergibt sich folgendes Bild, das sich nicht grundlegend von den Ergebnissen in Abb. 35 unterscheidet:

Tab. 45: Versetzexperiment bei *Peribatodes rhomboidaria*, bereinigt über die parallel laufenden 0 m-Werte.
Recapture-rates of Peribatodes rhomboidaria, released in different distances, after correction by the means of the 0 m-terms.

Versetzdistanz *distance of displacement*	0 m	30 m	60 m	90 m	120 m
W.f.-Quote, 1.Tag (%)	11,7	12,9	17,0	3,3	5,3
W.f.-Quote, Σ (%)	14,6	24,0	12,7	6,2	12,6

Im Prinzip gleiche Ergebnisse resultieren auch dann, wenn man nur die in der Hauptflugzeit dieser Art (1.8.-18.8.) gesammelten Daten berücksichtigt. Etwas aus dem Rahmen fallen lediglich die in einer Entfernung von 120 m ausgesetzten Tiere mit Wiederfang-Anteilen von 7,4 % (1. Tag) und 18,5 % (Gesamt).

Aus der Beobachtung, daß am 1. Tag nach dem Freilassen ein Gradient festzustellen ist, der sich danach einigermaßen ausgleicht, könnte man schließen, daß bei zufällig in verschiedene Richtungen startenden Exemplaren anfangs noch der Winkel zum Einzugsbereich der Lichtquelle bestimmend für die Wiederfang-Wahrscheinlichkeit ist. Später könnte durch "zickzackartige" Richtungsänderungen umherschweifender Falter ein Wiedereinfangen in den Trichter der Lichtfallen-Reichweite erfolgen.
In diesem Sinne ist mit zunehmender Versetzdistanz eine Verlängerung der Rückkehrdauer feststellbar (siehe Abb. 36).

Ortswechsler von SiN nach WaS (30 m) waren mit insgesamt nur 4,3 % gegenüber den versetzten Individuen (sogar dem 120 m-Wert) deutlich unterrepräsentiert. Hierbei mag die Barrierewirkung der Häuserzeile eine besondere Rolle gespielt haben.
Ähnliches gilt für die Ortswechsler in umgekehrte Richtung (2 Wiederfänge nach einem Tag). Die aus 90 m (1) und 120 m (2) nach SiN geflogenen Stücke wurden jeweils nach 2 Tagen wiedergefangen, was einen weiteren Hinweis auf eine Verlängerung der Rückkehrdauern bei zunehmender Distanz (vergleiche Abb. 36) darstellt.

Alcis repandata:

Tab. 46-48: Ausbeute, Markierungen und Wiederfänge im Garten 1988 bei *Alcis repandata*.
Numbers of individuals, marked specimens and recaptures of Alcis repandata in the garden 1988.

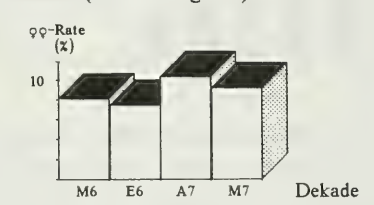
Ausbeute (Individuen)	SiN	WaS	Σ
♂♂	12	596	608
♀♀	2	55	57
entkommen	4	77	81
Σ	18	728	746
Par.	18	310	

Markierungen	SiN	WaS	Σ
♂♂	11	537	548
♀♀	2	53	55
Σ	13	590	603

Wiederfänge/Mehrfachwiederfänge	W.f. 1	2	3	4	5	6	7	8	Σ
♂♂	48	8	-	-	-	-	-	-	56
♀♀	2	-	-	-	-	-	-	-	2
Σ	50	8	-	-	-	-	-	-	58

In der Weibchen-Rate liegen ähnliche Verhältnisse vor wie bei *Peribatodes rhomboidaria*, sie betrug an SiN 14,3 %, an WaS 8,9 %. Das nicht optimale Anflugverhalten führte vermutlich zu der feststellbaren Unterrepräsentierung der ♀♀ im Wiederfangergebnis (siehe Bemerkungen zu *Peribatodes rhomboidaria*).
Ein proterandrisches Erscheinungsbild ist nicht erkennbar (Abbildung 37):

Abb. 37: Verlauf der Weibchen-Rate in der Flugzeit von *Alcis repandata* im Garten 1988.
Sex-ratio of Alcis repandata in the months of the flight time.



Intervall (Tage)	1	2	3	4	5	6	7	8	9	10	11	12	Σ
Wiederfänge	45	3	4	2	-	1	1	1	-	1	-	-	58

Tab. 49: Zwischen Fang und Wiederfang festgestellte Intervalle bei *Alcis repandata* 1988 im Garten.
Intervals (in days) between capture and recapture of Alcis repandata 1988 in the garden.

Das Intervall zwischen Fang und Wiederfang beträgt im Mittel 1,76 Tage. Auffällig ist auch die hohe Zahl von Intervallen über 2 Tagen (siehe Bemerkungen zu *Noctua pronuba).*

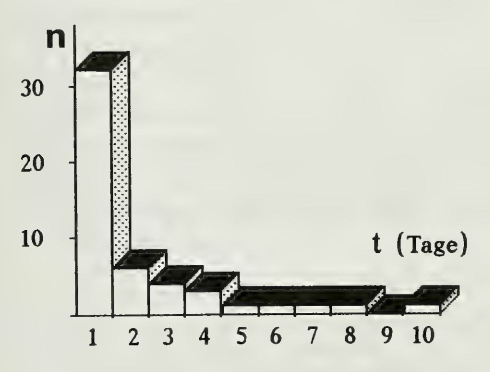


Abb. 38: Apparente Verweilzeiten von *Alcis repandata* 1988 im Garten.
Apparent residence times of Alcis repandata 1988 in the garden.

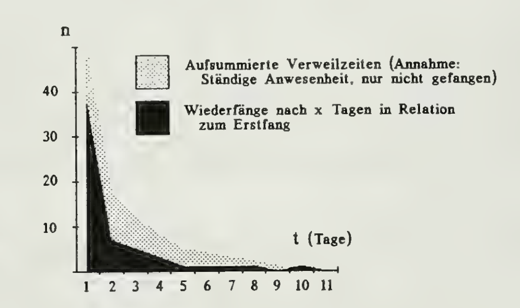


Abb. 39: Aufsummierte Verweilzeiten und real nach x Tagen beobachtete Wiederfänge.
Accumulated residence times and really after the time x recaptured specimens.

Die durchschnittliche Verweildauer von 2,08 Tagen liegt zwar über dem Wert von *Noctua pronuba*, jedoch nicht wesentlich. Dies ist, wie bereits unter *Peribatodes rhomboidaria* angedeutet wurde, durch eine Überrepräsentierung der bei 0 m freigelassenen Tiere verursacht. Diese verblieben durchschnittlich nur 1,35 Tage im Fallenbereich, bedingt durch einen hohen Anteil an Faltern, die sich eine Nacht lang an der Lichtquelle festhalten ließen! Geht man von einer gleichmäßigen Verteilung auf die verschiedenen Entfernungen aus, so ergibt sich ein theoretischer Wert von ungefähr 2,8 Tagen, also deutlich mehr als beim Wanderfalter *Noctua pronuba*.
Auch die relativ große Differenz der beiden Kurven in Abbildung 39 steht vermutlich im Zusammenhang mit einer niedrigeren Mobilität als beispielsweise bei *Noctua pronuba* oder *Amathes c-nigrum*.

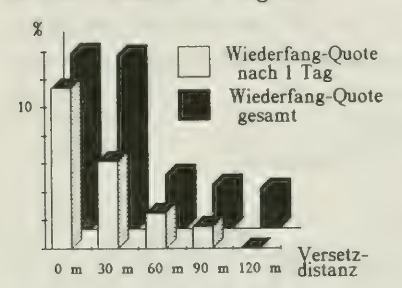


Abb. 40: Wiederfang-Quoten von *Alcis repandata* im Versetzexperiment.
Probability of recapture of Alcis repandata, released at different distances.

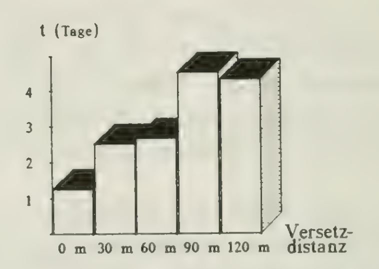


Abb. 41: Korrelation: Rückkehrdauer und Versetzdistanz.
Correlation of distance of displacement and time, needed for return.

Die in Abbildung 41 für 60, 90 und 120 m angegebenen Werte sind wegen der geringen Stichprobengröße (3, 2 und 2) noch wenig aussagekräftig.
Auch hier ergeben sich wie bei *Peribatodes rhomboidaria* für die Wiederfang-Wahrscheinlichkeiten der Mehrfachwiederfänge Prozentsätze, die dem Ergebnis bei 0 m entsprechen. Die Bereinigung mittels der gemittelten 0 m-Werte sowie die ausschließliche Berücksichtigung der Hauptflugzeit (17.6.-6.7.) führen im Prinzip zu den gleichen Aussagen, wie sie den Abbildungen 40 und 41 zu entnehmen sind.
Das von *Peribatodes rhomboidaria* deutlich unterschiedene Ergebnis könnte auf vermindert starke Ortsveränderungen im Zickzackmuster zurückzuführen sein. Vielleicht verbleibt ein Teil der Falter, die ab einer Entfernung von 60 m ausgesetzt wurden, an den entsprechenden Stellen. Wichtig ist jedoch, daß ein Muster, das dem des Wanderfalters *Noctua pronuba* ein wenig ähnelt – wenn auch ohne den starken Knick in der Kurve bei 30 m – , nicht unbedingt entsprechend interpretiert werden kann. Die durchschnittlich längeren Intervalle zwischen Fang und Wiederfang deuten auf ausgeprägte Unterschiede hin.

8.4.3. Vergleich der sich ergebenden Muster

Im Versetzexperiment waren in den Reaktionen z.T. deutliche Unterschiede zwischen den bekannten Wanderfaltern und den Arten, von denen kein Migrationsverhalten bekannt ist, erkennbar: *Noctua pronuba* und *Amathes c-nigrum* kehren nach einem Versetzen von 30 Metern und mehr nur mehr selten ans Licht zurück; der Prozentsatz dürfte von dem Winkel vom Freilaß-Punkt zum Einzugsbereich der Lichtquelle abhängen.

Ganz ähnliche Ergebnisse erzielte PLAUT (1971) beim Wanderfalter *Spodoptera littoralis* in einem ähnlichen Experiment.
Scotia clavis, Scotia exclamationis und *Rusina ferruginea* reagieren in etwa entsprechend, bei *Hoplodrina alsines* allerdings lassen sich schon Anzeichen für eine nicht so hohe Dynamik finden.
Stärker sind solche Hinweise bei *Meristis trigrammica, Peribatodes rhomboidaria* und *Alcis repandata.* Diese Arten schweifen vermutlich mehr oder weniger ungerichtet in der weiteren Umgebung herum und verursachen so Wiederfänge, die nicht durch die direkte Lichteinwirkung erkiärt werden können.
Die einzige relativ ortstreue Art, die getestet wurde, ist der Spanner *Calospilos sylvata.*
Im Garten war bei vielen Arten (z.B. *Peribatodes rhomboidaria*) die Barrierewirkung der Häuser- und Garagenzeile (siehe 8.1.) aufgefallen.

8.4.4. Hinweise für faunistische Arbeitsansätze

Bei Lebend-Lichtfallenfängen mit quantitativen Arbeitsansätzen erscheint es wichtig, nicht kontinuierlich zu fangen, da die Häufigkeiten durch verschiedene Wiederfang-Wahrscheinlichkeiten verzerrt werden.
Ein 2-Tage-Rhythmus ist als die günstigste Methodik anzusehen. Häufigkeitsverfälschungen spielen hier praktisch keine Rolle mehr.

Der direkte Einfluß der Lichtquelle (Schwarzlichtröhre) sinkt offensichtlich schon in Entfernungen von 30-50 m drastisch ab. Die Grenzwerte einer positiven Antwort sind artspezifisch verschieden. Diese Befunde entsprechen den Beobachtungen vieler anderer Forscher (z.B. GROTH, 1951; DANIEL, 1952; SCHADEWALD, 1955 und 1956; RETZ-BANYAI-RESER, 1986), auch wenn bezüglich der Reichweite noch andersartige Meinungen existieren (z.B. SCHEERPELTZ, 1968 oder URBAHN, 1973).
In einem Versetzexperiment ermittelte PLAUT (1971) für einen Wanderfalter die Fallenreichweite von ca. 30 m, in Tunnelexperimenten kamen GRAHAM et al. (1961) auf 40 m (allerdings an einer Argon-Lampe) und schließlich STEWART et al. (1969) auf maximal 60-135 m Entfernung für eine positive Antwort auf Lichtreize, ermittelt an jeweils nur einzelnen Arten.

8.5. RÜCKSCHLÜSSE AUS ORTSWIEDERFÄNGEN

8.5.1. Die Problematik

BETTMANN (1985 a; 1985 b; 1986) versuchte, über Interpretationen von Ortswiederfängen die verschiedenen Nachtfalter hinsichtlich ihrer Ortstreue zu charakterisieren. Ähnliches publizierten REINHARDT & DROBNIEWSKI (1979) für einige Tagfalterarten. Als Grundlage diente BETTMANN Material, das aus einer kontinuierlich arbeitenden Lichtfalle stammte.

Tab. 50: Wiederfänge bei Nacht-Großschmetterlingen in Rheydt (aus BETTMANN, 1986).
Recaptures of moths in Northern Germany (from BETTMANN, 1986).

Markiert *released*	Wiederfänge nach x Tagen *recaptures after x days*																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	>16
4877	131	26	9	1	1	-	-	1	1	-	-	1	-	-	-	-	1

Abgesehen von der auffällig niedrigeren Wiederfang-Quote von durchschnittlich 3,5 % gegenüber 18,8 % im Garten ab Mai 1988 (siehe Tab. 51) ergibt sich eine ähnliches Verteilungsmuster wie im Untersuchungsgebiet. Berücksichtigt man die Tatsache, daß BETTMANN die Wiederfänge nach x Tagen in Relation zum Erstfang ermittelte und nicht die apparenten Verweilzeiten, dann zeigt sich ein leichter Mangel an Wiederfängen über mehrere Tage hinweg.

Tab. 51: Fang-Wiederfang-Intervalle (Interv.) und Apparente Verweildauern (Verw.) bei täglichem Betrieb der Falle (WaS ab Mai 1988: 1 und 2) sowie Apparente Verweildauern aus Fängen mit fangfreien Nächten dazwischen (3).
Capture-recapture-intervals (1) and apparent residence times (2) in a garden in Southern Bavaria (daily catches); apparent residence times (3) in the study area (with census intervals of at least one night between the catches)

	Markiert *released*	Fang-Wiederfang-Intervall/Apparente Verweildauer (Tage) *Capture-recapture-interval/Apparent residence time (days)*																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	>16
1 WaS 1988 Interv.	4713	729	89	31	15	7	4	1	4	2	1	1	1	1	1	-	-	-
2 WaS 1988 Verw.		444	131	48	26	13	6	1	6	5	1	1	1	-	1	1	1	1
3 Gesamtfläche 1987/88 ohne 2	18.721	21*	146	72	29	23	20	12	8	6	5	2	4	1	1	1	1	1

* Ortswechsler SiN/WaS

Wenn wir nun die in 8.4. dargestellten Ergebnisse betrachten, wird schnell deutlich, welche Probleme Beurteilungen mit sich bringen, die sich ausschließlich auf Material aus kontinuierlichen Fängen stützen:

Von *Noctua pronuba* beispielsweise wurden über 40 % der Falter am nächsten Tag wiedergefangen (bei BETTMANN nur 1,2 %). Dieser Prozentsatz sinkt schon dann, wenn man jeweils nur eine fangfreie Nacht zwischen den Probeentnahmen läßt, je nach Standort auf Werte um oder unter 1 %.

Das bedeutet, daß eine Nacht (mit einigermaßen günstigen Flugbedingungen) genügt, um den Tieren ausreichend Gelegenheit zu bieten, sich in einem den natürlichen Gegebenheiten entsprechendem Maß zu vermischen. Bei einigen wenigen Arten, z.B. *Calospilos sylvata*, scheint dies schon durch Tagaktivitäten zu erfolgen.

Dies erklärt auch die Überrepräsentierung der 1-Tages-Wiederfänge, wie sie auch BETTMANN (l.c.) selbst hervorhebt. Es handelt sich hierbei zum Großteil um Tiere, die durch die direkte Lichtwirkung "gefangengehalten" wurden.

Ein weiteres bereits angesprochenes Problem ist die unterschiedliche Affinität der Arten und Geschlechter ans Licht: Bei einigen Weibchen beispielsweise (z.B. *Hoplodrina alsines*) wird nur ein kleiner Teil der tatsächlich anwesenden Individuen nachgewiesen. Diese geringeren Stichproben-Ausschnitte haben - methodisch bedingt - aber eine kleinere Wiederfangwahrscheinlichkeit zur Folge.

REZBANYAI-RESER (1986) erläutert in seiner Antwort auf die Veröffentlichungen BETTMANNs die Problematik in sieben Unterpunkten genauer und kommt zum Schluß, daß "die Ortstreue von Nachtgroßfaltern mit der Kombination der Markierungs- und Lichtfangmethode an einem einzigen Standort nicht ausreichend erforscht werden kann." Die offenbleibenden Fragen der Mortalität, der Möglichkeit eines unerkannten Verbleibens in der weiteren Umgebung u.s.w. "könnte man eventuell beantworten, wenn im weiteren Umkreis eines Markierungs-Standortes zahlreiche Lichtfallen oder Lichtfang-Beobachtungs-Stationen regelmäßig verteilt, aufgestellt würden. Wenn die an einem bestimmten Tag markierten Nachtgroßfalter aus der Gruppe der Nichtwanderer auch weiterhin am Leben bleiben und ihre Aktivität unverändert ist, müssen sie auch in den nächsten Tagen in der weiteren Umgebung durch Licht irgendwo angezogen werden. Eine solche Untersuchung wäre sehr wünschenswert. Sie ist jedoch äußerst zeit- arbeits- und personalaufwendig ..." (REZBANYAI-RESER, l.c.).

Es ist sicherlich richtig, daß Rückschlüsse aus Ortswiederfängen an einem Einzelstandort zu sehr verzerrten Ergebnissen führen können. Wenn man die in der von REZBANYAI-RESER (l.c.) postulierten Methodik (Fangstellen-Netz) gesammelten Daten miteinschließt, können Beurteilungen aus Ortswiederfängen gute Zusatzinformationen liefern.

8.5.2. Beispiel: *Amathes triangulum*

Insgesamt wurden bei 919 markierten Individuen 122 Wiederfänge registriert.
Im Garten (1988) verteilten sich Fänge und Wiederfänge folgendermaßen:

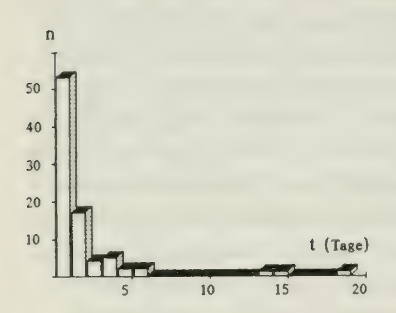
Tab. 51-53: Ausbeute, Markierungen und Wiederfänge im Garten 1988 bei *Amathes triangulum.*
Numbers of individuals, marked specimens and recaptures of Amathes triangulum in the garden 1988.

	Ausbeute (Individuen)			Markierungen			Wiederfänge/Mehrfachwiederfänge									
	SiN	WaS	Σ	SiN	WaS	Σ	W.f. 1	2	3	4	5	6	7	8	9	Σ
♂♂	37	313	350	33	311	344	72	14	5	2	2	2	1	1	1	100
♀♀	16	97	113	16	97	113	14	1	-	-	-	-	-	-	-	15
Σ	53	410	463	49	408	457	86	15	5	2	2	2	1	1	1	115
Par.	57	200														

Tab. 54: Zwischen Fang und Wiederfang festgestellte Intervalle bei *Amathes triangulum* 1988 im Garten (nur Ortswiederfänge an WaS).
Intervals (in days) between two catches of Amathes triangulum 1988 in the garden.

Intervall (Tage)	1	2	3	4	5	6	7	8	9	10	11	12	13	Σ
Wiederfänge	84	13	3	4	1	2	-	-	-	-	-	1	1	109

Das Intervall zwischen Fang und Wiederfang beträgt im Mittel 1,62 Tage.



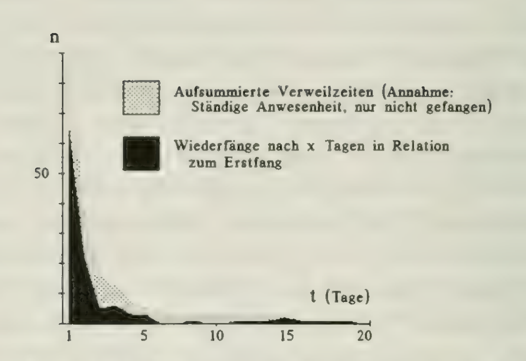


Abb. 42: Apparente Verweilzeiten von *Amathes triangulum* 1988 im Garten. *Apparent residence times of Amathes triangulum 1988 in the garden.*

Abb. 43: Aufsummierte Verweilzeiten und real nach x Tagen beobachtete Wiederfänge. *Accumulated residence times and really after the time x recaptured specimens.*

Die durchschnittliche apparente Verweildauer beträgt 2,20 Tage. Die ♀♀ (1,50 Tage, n = 14) scheinen wesentlich kürzer im Gebiet zu bleiben als die ♂♂ (2,63 Tage, n = 72). Die Weibchen-Rate nimmt auch bei den Wiederfängen, stärker noch bei den Mehrfachwiederfängen ab.

Nimmt man als Bewertungsgrundlage nur die im Garten 1988 gesammelten Daten, so ist die Ähnlichkeit mit dem bei *Hoplodrina alsines* (siehe 8.4.2.) festgestellten Muster am größten. Es handelt sich demnach um eine Noctuide, deren Mobilität eine Zwischenstellung zwischen den hochdynamischen Arten wie *Noctua pronuba* oder *Amathes c-nigrum* und der relativ häufig in der weiteren Umgebung verbleibenden *Meristis trigrammica* einnimmt.

Diese Beurteilung deckt sich mit den Ergebnissen der anderen Standorte (siehe z.B. 8.3.1.).

8.5.3. Beispiel: *Calospilos sylvata*

Diese Art eignet sich durch die vergleichsweise hohe Ortstreue und durch das zahlreiche Auftreten im Dachauer Moos gut zu Berechnungen der Populationsgröße. Da nur wenige Probeentnahmen bei relativ niedriger Fangfrequenz vorliegen, sind die Berechnungen als vorläufig anzusehen und bedürfen weiterer Untersuchungen zur Absicherung der Ergebnisse.

Teilt man das Produkt der beiden Fangergebnisse zweier Probeentnahmen (in der ersten Nacht nur die markierten Individuen) durch die Anzahl der in der zweiten Fangnacht wiedergefangenen Individuen so erhält man einen ersten Anhaltspunkt über die absolute Populationsgröße im Einzugsbereich der Lichtfalle.

So ergibt sich aus dem Fangergebnis vom 1.7.88 (159 markierte Falter) und den Beobachtungen vom 4.7.88 (126 Individuen, davon 22 Rückfänge) eine Populationsgröße von 911 Individuen.

Am selben Standort ergab sich bei einem in zwei aufeinanderfolgenden Nächten 1989 durchgeführten Versuch mit ähnlichen Stichprobengrößen ein Wert von 685 Individuen.

Einen Überblick über die Problematik solcher Berechnungen geben unter anderen EHRLICH & DAVIDSON (1961), JOLLY (1965), ZINNERT (1966) und ROFF (1973 a und b).

9. ÜBERSICHT ÜBER DIE REAKTION DER ARTEN

9.1. VORBEMERKUNGEN

Aufbauend auf den Ergebnissen der Markierungsexperimente und genaueren Betrachtungen der larvalökologischen Ansprüche wird versucht, das ganze im Untersuchungsgebiet nachgewiesene Artenspektrum hinsichtlich Dispersionsverhalten, trivial movement und Verbreitungsstrategien zu charakterisieren.

Nach einem **Überblick** über das 1987 und 1988 im Untersuchungsgebiet gesammelte Material erfolgt eine Wertung der **Wiederfangergebnisse**. Dies ist nötig, da nicht an allen Standorten mit der gleichen Methodik vorgegangen wurde.
Bei einem Materialumfang von über 100 markierten Exemplaren werden Markierungstabellen beigefügt. Hierin spiegelt "Σ par." das aus den streng vergleichbaren Parallelfängen stammende Fangergebnis wieder, während sich die unter "Σ zus." angegebenen Individuensummen auf die zusätzlichen Fänge beziehen.

In einem zweiten Schritt wird die betreffende Art in das von SCOTT (1975) vorgeschlagene System zur Beurteilung von (Tagfalter-)**Flugdistanzen** eingeteilt. Die vier Gruppen sind folgendermaßen definiert:

1 = "Very small movements" (gewöhnlich weniger als 100 m)
2 = "Larger movements" (manchmal einige 100 m)
3 = "Still larger movements" (manchmal 1 km)
4 = "Often move many kilometers (or can migrate many kilometers)": Bewegungen über viele Kilometer sind keine Seltenheit, hierher gehören auch die einheimischen Wanderfalter.

Durch die Gruppeneinteilung wird ein Bereich abgesteckt, in dem sich das trivial movement sowie der größte Teil des Dispersionsverhaltens abspielt. Auf die Zuteilung in eine 5. Gruppe (Wanderfalter über Distanzen von vielen Tausend Kilometern) soll hier verzichtet werden.

Über eine genaue Betrachtung der Larvalansprüche können weitere Rückschlüsse gezogen werden, diese sind im Abschnitt "**Larvalökologie**" festgehalten. Fehlende Nachweise biotopfremder Tiere theoretisch auch durch vermindertes Anflugverhalten an solchen Standorten bedingt sein. Dies erscheint jedoch angesichts der zahlreichen Beobachtungen von Gastarten unwahrscheinlich. Außerdem ist oft eine Korrelation zwischen ausgeprägten Häufigkeitsgradienten und stark lokal vorkommenden Raupenfutterpflanzen erkennbar.

Als Unsicherheitsfaktor ist hierbei zu berücksichtigen, daß in Einzelfällen die Literaturangaben zu Raupenfutterpflanzen nicht hinreichend präzise oder sogar falsch sind. Bei einer Reihe von Arten flossen daher in die Beurteilung eigene Beobachtungen mit ein.

Als weitere Hinweise zur "**Populationsbiologie**" werden Angaben über Bivoltinismus und sexuelle Koinzidenz gegeben, wenn möglich, erfolgen auch Schätzungen der Populationsgröße.

Der Versuch einer Einordnung in das **r-K-Kontinuum** ("r-Stratege", "K-Stratege", "intermediärer Typ") bildet den Abschluß der jeweiligen Artcharakteristik. Das r-K-Kontinuum stellt ein vereinfachtes Schema dar, ist aber, wie dies auch WEIDEMANN

(1986a; 1986b) für die Tagfalter und SRITZER & LEPS (1988) für die Nachtfalter betonen, eine plausible Art und Weise, Verbreitungsstrategien zu charakterisieren.
Als Beurteilungskriterien dienten
- die Ergebnisse aus den Fang/Wiederfangexperimenten
- Nachweise biotopfremder Tiere
- einige zusätzliche mehr oder weniger vage Hinweise, die mit der gebotenen Vorsicht behandelt wurden: Schlechte Flugtauglichkeiten (z.B. flügellose ♀♀), Ausmaß der "Nacht-zu-Nacht-Fluktuationen" und Häufigkeitsgradienten. Vor allem der letzte Parameter zeigt deutlich, wie vorsichtig man vorgehen muß, da auch hochmobile Wanderfalter z.T. in solchen Häufigkeitsgradienten auftreten, was auf "Zugstraßen" und nicht auf lokale Populationen zurückzuführen ist. Nach SCOTT (1975) sind solche Gradienten jedoch in heterogenen Lebensräumen Hinweise auf Arten mit kurzen Flugdistanzen. Arten, die mehr lokal verbreitet sind, benutzen relativ stabile Ressourcen und Habitate (GLAZIER, 1986), was ein Merkmal der K-Strategen darstellt.

Nicht berücksichtigt wurden hierbei Bi- bzw. Polyvoltinismus, welche nach MEINICKE (1984) und GATTER (1981) für hochmobile Arten typisch sind. Dasselbe gilt für die Fluktuationen von Generation zu Generation, deren Korrelation mit der Position im r-K-Kontinuum SPITZER & LEPS (1988) bei den Noctuiden Südböhmens belegten.
So können in einem zweiten Schritt die entsprechenden Zusammenhänge vergleichend getestet werden.

Abschließend wird die Art noch ergänzend hinsichtlich ihrer Verbreitung im Untersuchungsgebiet und ihrer beobachteten Habitat- bzw. Ortstreue charakterisiert. Hierzu dienen folgende 6 Gruppen:

1. Gruppe: Wanderfalter oder "wanderverdächtig" nach EITSCHBERGER & STEINIGER (1980).
2. Gruppe: Ubiquisten, deren Häufigkeit überall mehr oder weniger gleich ist.
3. Gruppe: Die Art ist mehr oder weniger überall anzutreffen, auch die Potenz zur Verbreitung und die Mobilität sind hoch, es sind jedoch Verbreitungsschwerpunkte festzustellen.
4. Gruppe: Die Art ist ebenfalls mehr oder weniger überall anzutreffen, sie ist jedoch vergleichsweise ortstreu; es existieren Verbreitungsschwerpunkte.
5. Gruppe: Die Habitatbindung ist relativ stark ausgebildet, dennoch sind die Potenz zur Verbreitung und die Mobilität (v.a. innerhalb des Habitats) groß.
6. Gruppe: Die Art ist in starkem Maße habitat- und ortstreu.

Es soll noch darauf hingewiesen werden, daß die Angaben die Verhältnisse im Untersuchungsgebiet wiederspiegeln; eine Übertragbarkeit auf andere Gebiete muß nicht unbedingt gegeben sein, beispielsweise wird die xerothermophile *Actinotia hyperici* im Norden Münchens aufgrund des Mangels an geeigneten Biotopen zweckmäßigerweise eine Strategie verfolgen, die eher in der K-Region zu suchen ist, während sie in Südeuropa, wo die Gefahr, in biotopfremdes Gelände verschlagen zu werden, geringer ist, als r-Stratege zu bezeichnen ist und manchmal in unvorstellbaren Mengen gefangen wird. Es ist an distalen Bereichen des Vorkommens von Arten also bisweilen nicht nur eine unterschiedliche ökologische Nischenbeanspruchung zu beobachten ("ökologische Kompensation", siehe WEIDEMANN, 1986, p. 52), sondern auch eine Änderung der Strategie.

9.2. ARTENLISTE

NOLIDAE

Celama confusalis (1 Individuum)

Distanzen: vermutlich 1-2
Verbreitungsstrategie: vermutlich K-Stratege,, 6. Gruppe

LYMANTRIIDAE

Dasychira selenitica

Distanzen: 1-2
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Dasychira pudibunda

36 Individuen 11,1 % ♀-Rate
33 markiert kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein
Distanzen: 3
Larvalökologie: im Raupenstadium an Rot-Buche, Birke, Hain-Buche und Eiche gebunden (KOCH, 1984), die beiden HM-Stücke sind also zugeflogen (mindestens 800-1000 m).
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Orgyia recens (7 Individuen)

Distanzen: ♀♀ 1 (flugunfähig); ♂♂ 3
Larvalökologie: im Raupenstadium an verschiedenen Laubhölzern (auch *Salix* spec.), das HM-Stück stammt also zumindest aus dem Ruderal (150-300 m).
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe; die ♀♀ sind durch den Verlust der Flugfähigkeit gezwungenermaßen biotop- und ortstreu, sie legen den Eivorrat meist auf dem Puppenkokon ab. Die ♂♂ sorgen dagegen durch ihre große Mobilität für eine gute Gendurchmischung. Bei der Kolonisation neuer Lebensräume spielen wohl die lang behaarten Eiräupchen, die leicht vom Wind verdriftet werden, eine besondere Rolle. Schon durch kurzes Anpusten können 1-3 m zurückgelegt werden.

Lymantria monacha

137 Individuen 1,4 % ♀- Rate
65 markiert 5 Wiederfänge

Wiederfang-Quote: niedrig, alle Wiederfänge WaS 1988 nach 1-Tages-Intervallen, also durch die direkte Lichtwirkung gefangengehalten.
Distanzen: 2-3
Larvalökologie: an Bäume gebunden (v.a. Nadelhölzer), die Strecke von 1 km (nach HM) wird normalerweise nicht bewältigt, schon in 50 m Entfernung vom Nadelwaldrand starker Rückgang der relativen Häufigkeit (siehe Wasserwerk)
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; bei Massenvermehrungen wohl erhöhte Mobilität; SCHWERDTFEGER (1978) berichtet von Massenflügen dieser Art, wobei es sich seiner Meinung nach nur um einen passiven Transport (Wind) handelte.

Euproctis chrysorrhoea (2 Individuen)

Distanzen: 2-3
Larvalökologie: im Raupenstadium an Laubholz gebunden, vor allem an Obstbäume und Eiche. Das HM-Exemplar (♂) legte also wahrscheinlich 800-1000 m zurück.
Verbreitungsstrategie: vermutlich r-Stratege, 3. Gruppe

Porthesia similis

138 Individuen 13,8 % ♀- Rate
46 markiert kein Wiederfang

Wiederfang-Quote: wohl niedrig, die Probeentnahme erfolgte im Moos jedoch nur in wöchentlichen Abständen
Distanzen: 2 (im Siedlungsbereich noch nie festgestellt!)
Verbreitungsstrategie: K-Stratege, 6. Gruppe

ARCTIIDAE

Cybosia mesomella

167 Individuen   0 % ♀- Rate

49 markiert   1 Wiederfang

Wiederfang-Quote: ein Wiederfang (♂) erfolgte nach 6 Tagen (WaN→WNo = 50 m)
Distanzen: 2-3
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Miltochrista miniata (9 Individuen)

Distanzen: 1-2
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Lithosia quadra (17 Individuen)

Distanzen: 2-3
Larvalökologie: die Raupen dieser Art können bei Massenvermehrungen von *Lymantria monacha* als Mordraupe zur Einregulierung der Bestände dieses Schädlings beitragen.
Verbreitungsstrategie: vermutlich ähnlich wie *L. monacha* intermediärer Typ, 5. Gruppe; nach URBAHN (1973) mit langfristigen Häufigkeitsschwankungen

Eilema depressa

siehe verringerte Fallendistanzen 8.3.

713 Individuen   55,1 % ♀- Rate

575 markiert   4 Wiederfänge

Tab 55: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Eilema depressa*

1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH, MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	-	-	3	13	12	61	42	1	1	2	135
Σ zus.	-	-	8	-	-	3	4	-	-	-	15
♂♂	-	-	6	9	6	35	17	1	-	2	75
♀♀	-	-	6	4	5	26	28	-	1	-	70
Mark.	-	-	11	12	10	57	32	1	1	2	126
W.f.	-	-	-	1	-	-	-	-	-	-	1

1988	Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH, MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	71	13	173	152	81	107	2	4	-	1	5[illegible]
Σ zus.	-	23	-	-	-	-	-	-	-	-	[illegible]
♂♂	3	9	86	62	37	39	1	2	-	-	2[illegible]
♀♀	4	27	85	87	43	66	1	2	-	-	3[illegible]
Mark.	6	27	146	124	66	76	1	3	-	-	4[illegible]
W.f.	-	-	1	-	2	-	-	-	-	-	

Wiederfang-Quote: gering! An WaS trotz täglichem Fang 1988 kein Rückfang; WaS 1987 ein ♂ nach 2 Tagen wiedergefangen
Distanzen: 3
Larvalökologie: die Raupen leben an Nadelholzflechten, die Strecke nach HM (> 800 m) wird regelmäßig bewältigt.
Populationsbiologie: deutlich proterandrisch!
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Eilema lutarella (1 Individuum)

Distanzen: vermutlich 2
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Eilema complana

52 Individuen   36,6 % ♀- Rate

40 markiert   1 Wiederfang

Wiederfang-Quote: wohl durchschnittlich, der Wiederfang (♀, HO) erfolgte nach 3 Tagen.
Distanzen: 2-3
Verbreitungsstrategie: r-Stratege, 5. Gruppe

Eilema lurideola (9 Individuen)

Distanzen: vermutlich 2-3
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Systropha sororcula

153 Individuen 14,2 % ♀-Rate

112 markiert kein Wiederfang

Tab 56: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Systropha sororcula.*

1987	SIEDLUNG		WALD Garten				HALBTROKKENRASEN			"DACHMOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	-	-	1	1	3	5	30	-	-	3	43
Σ zus.	-	-	4	4	-	14	-	-	-	-	22
♂♂	-	-	2	1	2	12	21	-	-	-	38
♀♀	-	-	-	1	-	6	2	-	-	1	10
Mark.	-	-	2	2	2	18	23	-	-	1	48
W.f.	-	-	-	-	-	-	-	-	-	-	-

1988	WALD Garten		WALD Wasserwerk			HALBTROKKENRASEN			"DACHMOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	1	-	16	15	18	34	-	-	1	2	87
Σ zus.	-	1	-	-	-	-	-	-	-	-	1
♂♂	1	1	8	12	12	23	-	-	-	2	59
♀♀	-	-	2	1	2	1	-	-	-	-	6
Mark.	1	1	9	13	14	24	-	-	-	2	64
W.f.	-	-	-	-	-	-	-	-	-	-	-

Wiederfang-Quote: sehr niedrig
Distanzen: 3; innerhalb des Habitats ist die Art beweglicher (siehe "Wiederfang-Quote") als außerhalb davon (siehe "Larvalökologie")
Larvalökologie: im Raupenstadium auf Laub- und Nadelholzflechten angewiesen, das HM-Stück ist also ein Zuflieger, die Strecke von (mindestens) 800-1000 m über biotopfremdes Gebiet wird nur gelegentlich bewältigt.
Populationsbiologie: proterandrisch; HO am 11.6.88 ein "schwarmartiges" Auftreten (21 Ex.), 2 Tage davor und danach jedoch kein einziges Stück; solch starke Fluktuationen von Nacht zu Nacht sind oft mit Ortswechsel-Ereignissen korreliert.
Verbreitungsstrategie: r-Stratege, 5. Gruppe

Atolmis rubricollis (85 Individuen)

Distanzen: 2
Larvalökologie: Larvalansprüche wie bei der vorhergenannten Art, im Offenland bisher jedoch noch nie beobachtet.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Phragmatobia fuliginosa

382 Individuen 6,8 % ♀-Rate

360 markiert 4 Wiederfänge

Tab 57: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Phragmatobia fuliginosa.*

1987	SIEDLUNG		WALD Garten				HALBTROKKENRASEN			"DACHMOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	1	2	1	-	10	35	65	41	48	12	215
Σ zus.	-	1	-	-	-	-	10	6	-	-	16
♂♂	1	1	1	-	8	33	69	43	45	10	211
♀♀	-	-	-	-	2	2	4	1	3	1	13
Mark.	1	1	1	-	10	35	70	43	43	11	215
W.f.	-	-	-	-	1	-	-	1	2	-	4

1988	WALD Garten		WALD Wasserwerk			HALBTROKKENRASEN			"DACHMOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	1	9	31	14	22	33	9	22	5	4	150
Σ zus.	-	1	-	-	-	-	-	-	-	-	1
♂♂	1	10	27	14	18	30	7	19	5	3	134
♀♀	-	-	4	-	2	3	1	2	-	-	12
Mark.	1	9	31	14	20	33	8	21	5	3	145
W.f.	-	-	-	-	-	-	-	-	-	-	-

Wiederfang-Quote: vergleichsweise niedrig, alle Wiederfänge erfolgten schon 2 Tage nach dem Erstfang, auch am Wasserwerk 1988 keine besonders starke Ortstreue nachgewiesen.
Distanzen: 3; an SiS ist eine starke Häufigkeitsabnahme gegenüber dem Flughafengebiet (200-300 m Entfernung), in dem die Art wohl allgemein häufig ist, festzustellen. Vermutlich ist ein Großteil der in der Siedlung festgestellten Exemplare zugeflogen. Am 29.7.88 wurde hier aus einem wohl durchziehenden "Schwarm" 8 Stücke gefangen, tags darauf war noch ein Tier festzustellen, dann keines mehr.
Populationsbiologie: bivoltin; im Mai 1989 wurden 3 ♂♂ tagsüber bei hoher Agilität gekäschert. Ein Nachweis einer solchen Flugaktivität steht für die 2. Generation noch aus.
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe; vermutlich können auch die recht schnell laufenden Raupen (v.a. an warmen Herbsttagen) 100 m und mehr zurücklegen.

Spilarctia lubricipeda (116 Individuen)

Distanzen: 2–3
Larvalökologie: findet durch Polyphagie überall Lebensgrundlage
Verbreitungsstrategie: K–Stratege, 4. Gruppe; zur Konstanz der Populationsverhältnisse vergleiche REICHHOLF (1974).

Spilosoma menthastri

siehe verringerte Fallendistanzen (8.3.) und Versetzexperiment (8.4.)

434 Individuen 10,1 % ♀-Rate

421 markiert 23 Wiederfänge

Tab 58: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Spilosoma menthastri.*

1987	SIEDLUNG		Garten		WALD		HALBTROKKENRASEN			*DACHMOOS*	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	3	3	3	2	2	25	25	3	46	23	135
Σ zus.	–	–	2	8	–	34	–	–	–	–	44
♂♂	3	2	4	6	2	58	20	3	40	18	156
♀♀	–	1	1	4	–	1	4	–	6	3	20
Mark.	3	3	5	10	2	58	23	3	45	21	173
W.f.	–	–	–	1	–	2	2	–	–	–	5

1988	Garten		WALD Wasserwerk			HALBTROKKENRASEN			*DACHMOOS*	
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We
Σ par.	3	6	41	28	60	39	4	37	17	13
Σ zus.	–	7	–	–	–	–	–	–	–	–
♂♂	2	10	36	27	55	35	2	32	17	12
♀♀	1	3	3	1	5	3	2	4	–	1
Mark.	3	13	38	27	60	38	4	35	17	13
W.f.	–	7	6	1	2	1	–	1	–	–

Wiederfang-Quote: hoch, bei langen Verweildauern: Die 1987 insgesamt sowie die 1988 an HO und HW registrierten Rückfänge (6 ♂♂, 1 ♀) erfolgten nach einem Intervall von durchschnittlich 4,6 Tagen.
Distanzen: 2
Larvalökologie: *S. menthastri* findet durch Polyphagie überall eine Lebensgrundlage.
Populationsbiologie: der ♀♀-Anteil an den Wiederfängen entspricht in etwa der ♀-Rate der Erstfänge. Dennoch dürften die ♀♀ – vor allem diejenigen mit vollem Eivorrat – ortstreuer als die ♂♂ sein. Ein nicht optimales Anflugverhalten der ♀♀ könnte das Wiederfangergebnis verfälscht haben. Die Konstanz der Populationsverhältnisse entspricht den Befunden in REICHHOLF (1974).
Verbreitungsstrategie: K–Stratege, 4. Gruppe; die schnelllaufenden Raupen können 100 m und mehr zurücklegen.

Diacrisia sannio

siehe verringerte Fallendistanzen (8.3.)

167 Individuen 0 % ♀-Rate

90 markiert* 6 Wiederfänge* *1989 weitere 19 markiert, 2 Wiederfänge

Tab 59: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Diacrisia sannio.*

1988	Garten		WALD Wasserwerk			HALBTROKKENRASEN			*DACHMOOS*		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	–	–	19	14	24	6	4	34	1	–	102
♂♂	–	–	19	14	24	6	4	34	1	–	102
♀♀	–	–	–	–	–	–	–	–	–	–	–
Mark.	–	–	17	12	21	6	4	29	1	–	90
W.f.	–	–	2	1	3	–	–	–	–	–	6

Wiederfang-Quote: am Wasserwerk hoch, am Flughafen bei vergleichbarer Abundanz niedrig! Die Ortstreue muß also nicht eine artspezifische Konstante sein, sondern kann auch vom Biotop oder von der Geländestruktur abhängen. Auffallend sind bei dieser Art die langen Verweildauern.
Distanzen: 2–3; im Ort wurde diese Art noch nie beobachtet, die Strecke von 1 km wird also, zumindest über biotopfremdes Gebiet, so gut wie nie bewältigt.
Populationsbiologie: tagsüber sind durchaus auch ♀♀ zu beobachten. Bivoltin.
Verbreitungsstrategie: K–Stratege, 6. Gruppe

Arctia caja

149 Individuen 24,4 % ♀-Rate

49 markiert 9 Wiederfänge

Wiederfang-Quote: alle 9 Wiederfänge beziehen sich auf ein ♂ (SiN 1988), das die Falle in 10 aufeinanderfolgenden Nächten anflog.
Distanzen: 2-3, die nur recht vereinzelt im Ort anzutreffenden Stücke werden meist am Flugzeitende beobachtet (Zuflug?).
Populationsbiologie: man könnte sich die Population in einem dynamischen Fließgleichgewicht befindlich vorstellen, das zu dem beobachteten Ost/West-Gradienten in der Häufigkeit führt.
Verbreitungsstrategie: r-Stratege, 3. Gruppe; die schnellaufenden Raupen können vermutlich 100 m und mehr zurücklegen.

ENDROSIDAE

Pelosia muscerda (1 Individuum)

Distanzen: vermutlich 2 (-3 ?);
Verbreitungsstrategie: vermutlich K-Stratege, 5. Gruppe; der Lebensraum am Wasserwerk wurde jedoch vor einigen Jahren neu besiedelt, höchstwahrscheinlich sogar über viele km hinweg (nächstgelegenes bekannte Vorkommen: Isarauen bei Landshut, ca. 40 km, vielleicht aber auch bei Ismaning: ca. 7 km).

NOTODONTIDAE

Harpyia furcula (3 Individuen)

Distanzen: vermutlich 2-3
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Cerura vinula

15 Individuen 20,0 % ♀- Rate

15 markiert kein Wiederfang

Wiederfang-Quote: Stichprobe zu klein
Distanzen: 3
Larvalökologie: Raupenfunde im Gebiet bisher nur an *Salix* spec.; die HM-Exemplare stammen wohl aus dem Ruderal, die nächstgelegenen Raupenfutterpflanzen liegen in dieser Richtung 200-300 m entfernt. Die SiN-Stücke sind ebenfalls zugeflogen: Einzelstehende Weiden sind in einer Entfernung von ca. 200-300 m zu finden.
Verbreitungsstrategie: r-Stratege, 5. Gruppe

Stauropus fagi

21 Individuen 0 % ♀- Rate

16 markiert kein Wiederfang

Wiederfang-Quote: Stichprobe zu klein
Distanzen: 2-3
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Hybocampa milhauseri (1 Individuum)

Distanzen: vermutlich 2
Larvalökologie: monophag an Eiche; das ♀ im Franzosenhölzl 1989 flog mindestens 50 m weit zur Lichtfalle, sonst nur im typischen Habitat.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Gluphisia crenata (5 Individuen)

Distanzen: 2-3
Larvalökologie: auf *Populus* spec. spezialisiert; von den Fundorten SiM und HW liegen die nächstgelegenen Pappelvorkommen jeweis ca. 200 m entfernt.
Verbreitungsstrategie: K-Stratege, 5. Gruppe. Die Kolonisierung des Raums Oberschleißheim in den letzten Jahrzehnten erfolgte vermutlich von den Isarauen her, die an der nächsten Stelle 7 km entfernt sind. Hierbei könnte die Begleitvegetation des Schloßkanalsystems als Trittstein(e) eine besondere Rolle gespielt haben.

Drymonia trimacula

24 Individuen 0 % ♀- Rate

23 markiert kein Wiederfang

Wiederfang-Quote: wohl niedrig, Stichprobe noch zu klein
Distanzen: 2-3
Larvalökologie: oligophag (im Gegensatz zur folgenden Art)

Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; die Oligophagie erlaubt der Art eine größere Mobilität, die Gefahr, in ungeeignete Biotope zu gelangen ist geringer als bei einer monophagen Art wie *Drymonia ruficornis*.

Drymonia ruficornis

56 Individuen 18,2 % ♀-Rate

55 markiert 2 Wiederfänge

Wiederfang-Quote: relativ hoch; die beiden Wiederfänge (♂♂, HO) erfolgten nach jeweils 2 Tagen.
Distanzen: im Habitat 2-3, außerhalb 1-2
Larvalökologie: eine monophag an Eiche gebundene Art, die sehr biotoptreu ist: Sie wurde an den Fangplätzen HM und HW nie festgestellt, obwohl sie im Kiefern-Eichenwaldgürtel rund um den Flughafen herum allgemein verbreitet ist (1989 wurde auch südlich des Flughafengebiets eine beträchtliche Anzahl gefangen!). Von HO liegen die nächstgelegenen Vorkommen ca. 800-1000 m, von HW 500-600 m entfernt, einzelstehende Eichen befinden sich in letzterem Fall sogar noch näher. Der normale Aktionsradius über biotopfremdes Gebiet von *D. ruficornis* sollte also unter diesen Werten liegen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Peridea anceps

112 Individuen 5,5 % ♀-Rate

110 markiert 5 Wiederfänge

Tab 60: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Peridea anceps*

1987	SIEDLUNG		WALD Garten		WALD		HALBTROKKENRASEN			"DACHMOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	-	-	1	3	6	3	20	-	3	1	36
Σ zus.	-	-	2	3	-	-	-	-	-	-	5
♂♂	-	-	3	5	6	2	17	-	2	1	36
♀♀	-	-	-	1	-	-	2	-	1	-	4
Mark.	-	-	3	6	6	2	19	-	3	1	40
W.f.	-	-	-	-	-	-	1	-	-	-	1

1988	WALD Garten		WALD Wasserwerk			HALBTROKKENRASEN			"DACHMOOS"	
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We
Σ par.	3	2	2	-	3	56	1	1	2	-
Σ zus.	-	1	-	-	-	-	-	-	-	-
♂♂	3	2	2	-	3	54	1	1	2	-
♀♀	-	1	-	-	-	1	-	-	-	-
Mark.	3	3	2	-	3	55	1	1	2	-
W.f.	-	-	-	-	-	4	-	-	-	-

Wiederfang-Quote: hoch, bezogen auf den Fangplatz HO 7,8 %! Bei den Wiederfängen handelt es sich um 5 ♂♂, die nach einer durchschnittlichen Verweildauer von 2,8 Tagen wiedergefangen wurden.
Distanzen: 2-3
Larvalökologie: Wie die vorige Art monophag an Eichen. Im Prinzip gilt das für *D. ruficornis* Gesagte, eine etwas größere Mobilität ist jedoch festzustellen. Die HW-Stücke, vor allem das ♀ stammen wohl von den einzelstehenden Bäumen der näheren Umgebung: 2-3 m hohe Eichen finden sich schon in ca. 100 m Entfernung.
Das HM-Stück ist jedoch aus mindestens 800-1000 m Entfernung bei windstillem Wetter zugeflogen, was aber vielleicht schon die obere Grenze der Reichweite über biotopfremdes Gebiet darstellt. Diese Art fällt auch durch einen etwas plumpen Flug auf. Im Franzosenhölzl wurden 1989 in 50 m Entfernung zu einer einzelstehenden Eiche 7 Exemplare, in 90 m Entfernung nur noch 2 Exemplare gefangen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Pheosia tremula

54 Individuen 0 % ♀-Rate

43 markiert kein Wiederfang

Wiederfang-Quote: relativ niedrig, im Birket 1987, wo die meisten Markierungen erfolgten, wurde allerdings nur in wöchentlichem Fangrhythmus gefangen.
Distanzen: 2-3
Larvalökologie: im Larvenstadium hauptsächlich an Pappeln und Weiden. Die an HM gefangenen Tiere stammen wohl aus den 150-300 m entfernten Weidenbeständen des Ruderals. An den auch im Ort vorkommenden Birken kann *P. tremula* offenbar keine auf Dauer erfolgreichen Kolonisationsversuche durchführen: Das Exemplar 1986 im Garten war vermutlich ein Zuflieger.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Pheosia gnoma

75 Individuen 0 % ♀-Rate

73 markiert 2 Wiederfänge

Wiederfang-Quote: niedrig! Die beiden Falter (WaS 1988) waren durch die direkte Lichtwirkung festgehalten worden, ihre Rückfänge erfolgten nach jeweils 1 Tag.
Distanzen: 3-4
Larvalökologie: die Raupen fressen monophag an Birken. Umso erstaunlicher ist das fast regelmäßige Auftreten im Offenland (HM), wovon die nächstgelegenen Raupenfutterpflanzen 800-1000 m entfernt sind. Der Zuflug war hier im Jahr 1987 in beiden Fällen von Westwinden begünstigt.
1988 wurden 10 der 12 WaS gefangenen Falter an 2 aufeinanderfolgenden Tagen gefangen, was eher durch "schwarmartiges" Auftreten als durch eine erfolgreiche Brut in der näheren Umgebung zu erklären ist: Ein solch synchrones Schlüpfen sollte ein Zufall sein.
1989 tauchte *P. gnoma* im Garten zum ersten Mal in der ersten Generation auf (frisches Stück). Es handelt sich vermutlich um eine erfolgreiche Kolonisation der 1988 zugeflogenen Exemplare.
Populationsbiologie: bivoltin
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Notodonta phoebe

Distanzen: vermutlich 2-3
Verbreitungsstrategie: vermutlich intermediärer Typ.

Notodonta dromedarius

27 Individuen 3,8 % ♀-Rate

26 markiert kein Wiederfang

Wiederfang-Quote: relativ niedrig, Stichprobe jedoch noch zu klein.
Distanzen: 2-3
Larvalökologie: oligophag an einigen Laubholzarten; die Herkunft der HM-Stücke liegt wahrscheinlich in den Weidenbeständen des Ruderals (150-300 m), diese Strecke scheint regelmäßig bewältigt zu werden.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Notodonta ziczac

46 Individuen 14,0 % ♀-Rate

43 markiert 1 Wiederfang

Wiederfang-Quote: durchschnittlich; ein 1987 an HM nach 2 Tagen rückgefangenes ♂ war in der dazwischenliegenden Nacht (günstige Flugnacht) wohl nicht am Fangplatz verblieben, an dem die Art als "biotopfremd" anzusprechen ist. Vermutlich flog das Stück die 150-300 m in das Ruderal (zurück) und dann erst wieder an die Lichtfalle, was einer Mindest-Gesamtstrecke von 450-900 m entspricht, unter der (Minimal-)Annahme, daß das ♂ aus dem Ruderal stammt.
Distanzen: 3-4
Larvalökologie: Raupenfutterpflanzen sind *Salix*- und *Populus*arten. Die Mindestflugstrecke der an HM festgestellten Tiere beträgt also 150-300 m (Ruderal), die der im Garten gefangenen Stücke 200-300 m. Diese Entfernungen werden ohne Probleme und in größeren Stückzahlen geflogen, im Falle des Gartens auch einmal von einem ♀.
Populationsbiologie: bivoltin
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Leucodonta bicoloria

17 Individuen 0 % ♀-Rate (1989 1 ♀ am Licht)

13 markiert 2 Wiederfänge

Wiederfang-Quote: relativ hoch, Stichprobe jedoch noch zu klein. Ein Wiederfang ist methodisch durch den direkten Lichteinfluß begründet, es handelt sich um ein nach einem Tag rückgefangenes Tier 1988 WaS. Ein anderes ♂ wurde 1988 an HO nach 2 Tagen wiedergefangen.
Distanzen: 2-3
Larvalökologie: monophag an Birke (nur selten Eiche). Diese Art ist nach OSTHELDER (1925-1933) sowie nach WOLFSBERGER (1974) in Schleißheim bzw. allgemein ein typischer Bewohner der Birkenmoore, L. bicoloria wich wahrscheinlich erst in den letzten Jahrzehnten nach der Trockenlegung des Dachauer Mooses verstärkt auf andere Waldgebiete aus. Trittsteine für eine solche Besiedlung sind in ausreichendem Maße vorhanden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Odontosia carmelita (1 Individuum)

Distanzen: vermutlich 2-3
Larvalökologie: Futterpflanzen nur Birke, Erle; bisher keine biotopfremden Tiere
Populationsbiologie: Art mit lokalem, inselartigem Vorkommen bei meist geringer Populationsdichte
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Lophopteryx camelina

93 Individuen   2,2 % ♀-Rate

78 markiert   2 Wiederfänge

Wiederfang-Quote: niedrig, beide rückgefangenen ♂♂ nach 1-Tages-Intervallen (1988, WaS)
Distanzen: 2-3
Larvalökologie: die Raupe ist auf Laubbäume angewiesen, das HM-♂ 1988 flog also mindestens vom Ruderal her zu (150-300 m).
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Lophopteryx cuculla

19 Individuen   0 % ♀-Rate

16 markiert   kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe jedoch noch zu klein
Distanzen: 2-3
Larvalökologie: oligophag an Ahornarten; an die HM-Falle flog 1986 bei windstillem Wetter ein Exemplar, das mindestens 500 m zurückgelegt hatte: In dieser Entfernung befinden sich einige junge Ahornbäumchen (Alleeanpflanzung).
Populationsbiologie: die Generationenfrage ist im Untersuchungsgebiet noch ungeklärt: Die Daten bis 1988 deuten auf Monovoltinismus hin, wie in KOCH (1984) beschrieben. Das Exemplar E5 1989 ist jedoch ein Hinweis auf "zwei voneinander unabhängige Stämme" (FORSTER & WOHLFAHRT, 1960).
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Ptilophora plumigera

14 Individuen   "0 %"   ♀-Rate

1 markiert   1 Wiederfang

Wiederfang-Quote: Stichprobe natürlich noch zu klein: 1 ♂ (WaS) nach 2 Tagen, in der dazwischenliegenden Nacht erfolgte kein Lichtfang.
Distanzen: 2
Larvalökologie: wie *L. cuculla*, jedoch keine biotopfremden Tiere festgestellt
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Pterostoma palpina

21 Individuen   0 % ♀-Rate

20 markiert   kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein
Distanzen: 3-4
Larvalökologie: polyphag Laubbäume (v.a. Weide, Pappel); die Strecke Ruderal→HM (150-300 m) wird ähnlich wie bei *Notodonta ziczac* ohne Probleme und regelmäßig geflogen.
Populationsbiologie: bivoltin
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Phalera bucephala

97 Individuen   4,2 % ♀-Rate

95 markiert   4 Wiederfänge

Wiederfang-Quote: durchschnittlich; 3 ♂♂ , die im Garten (WaS) nach einem 1-Tages-Intervall wiedergefangen wurden, erklären sich durch das Gefangenschaft im Anziehungsbereich der täglich betriebenen Lichtfalle, 1 ♂ wurde im Birket 1987 nach 5 Tagen wiedergefunden.
Ein markiertes ♂ ging interessanterweise am nächsten Tag in der Falle eine Kopula mit einem unmarkierten ♀ ein.
Distanzen: 3
Larvalökologie: Larvalansprüche sowie Bemerkungen wie bei *Pterostoma palpina*
Verbreitungsstrategie: r-Stratege, 3. Gruppe; im Ort wurden (ähnlich wie bei *Phragmatobia fuliginosa* und *Pheosia gnoma*) 1988 sämtliche nachgewiesenen Stücke an

zwei aufeinanderfolgenden Tagen registriert. Ein solches Auftreten in "Schwärmen" im Siedlungsbereich steht den vermutlich geringeren Dispersionsaktivitäten in feuchteren Wäldern (Dachauer Moos) gegenüber.

Clostera curtula

28 Individuen — 4,3 % ♀-Rate

23 markiert — kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein
Distanzen: 2-3, in der 2. Generation mit größerer Dispersionsaktivität
Larvalökologie: an *Salix* spec. und *Populus* spec.. Die nächstgelegenen Raupenfutterpflanzen liegen von SiM wie von HM ca. 200-300 m entfernt. Solche Distanzen scheinen ohne Mühe und regelmäßig bewältigt zu werden. Im Garten wurde *C. curtula* dagegen nur einmal 1989 beobachtet: Die Distanz von 1 km (von SiM) bzw. 1,3 km (Wasserwerk) liegt nicht im normalen Aktionsradius der Art und wird nur ausnahmsweise geflogen.
Biotopfremde Tiere treten vor allem in der 2. Generation auf!
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Clostera anachoreta (3 Individuen)

Distanzen: vermutlich 2-3
Larvalökologie: wie *C. curtula*, biotopfremde Tiere wurden noch nicht beobachtet.
Populationsbiologie: bivoltin
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Clostera pigra

21 Individuen — 4,8 % ♀-Rate

18 markiert — kein Wiederfang

Wiederfang-Quote: wohl niedrig, Stichprobe noch zu klein
Distanzen: 2-3
Larvalökologie: wie *C. curtula*. Die Distanz von 150-300 m (Ruderal→HM) liegt auch hier im Bereich der normalen Dispersion. Die Strecke von 1 km (Zuflug in den Garten) wird im Normalfall nicht bewältigt. Das Exemplar am S-Bahnhof 1988 muß mindestens 300 m zurückgelegt haben (nächstgelegene Raupenfutterpflanze).
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

ZYGAENIDAE

Diese Familie soll hier ausgeklammert werden, da die Imagines tagaktiv und mit Lichtfang nicht zu erfassen sind.
Die Dispersionsaktivitäten von 5 Arten (darunter *Zygaena filipendulae* und *Huebneriana lonicerae*) sind in SMOLIS & GERKEN (1986) ausführlich abgehandelt, zu den ökologischen Ansprüchen der Arten siehe BLAB (1982).

COCHLIDIIDAE

Apoda limacodes (196 Individuen)

Distanzen: 3-4
Larvalökologie: als Raupe an Laubgehölzen, v.a. Eiche und Buche. Nach HM, wo *A. limacodes* keine Lebensgrundlage hat, erfolgt regelmäßig ein Zuflug, der seinen Ursprung in mindestens 150-300 m Entfernung (Ruderal) hat, vermutlich jedoch in den umliegenden Wäldern, deren Mindestabstand 800-1000 m beträgt.
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Heterogenea asella (1 Individuum, ca. 45 Kokons)

Distanzen: 1-2
Larvalökologie: oligophag an Laubbäumen, v.a. Buche (*Fagus sylvaticus*); im Vergleich mit der vorigen Art mit eingeschränktem Wirtspflanzenspektrum. Die Fundorte der Kokons konzentrieren sich auf ein relativ kleines Areal (ca. 50 ha) im Nordosten des Berglwalds. An anderen Stellen des Berglwaldes wurde mit gleicher Intensität ohne Erfolg gesucht.
Die im Berglwald eingestreuten Buchenenklaven (je ca. 200 m^2) liegen in Abständen von durchschnittlich etwa 100 m, die offensichtlich noch bewältigt werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe. Der Unterschied in der Strategie dieser Art zur vorigen erklärt sich nicht nur durch das eingeschränkte Wirtspflanzenspektrum, sondern auch durch die Kleinheit der wohl schlecht fliegenden Imagines.

SPHINGIDAE

Mimas tiliae

35 Individuen   3,1 % ♀-Rate

32 markiert   kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein
Distanzen: 3-4
Larvalökologie: oligophag an Laubbäumen, das HM-Stück (1986) flog aus mindestens 800-1000 m herbei.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Laothoe populi

23 Individuen   13,0 % ♀-Rate

21 markiert   kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein
Distanzen: 3
Larvalökologie: Futterpflanzen: Arten der Gattungen *Salix* und *Populus*; die Distanz von 150-300 m wird also häufig zurückgelegt: Zufliegende Exemplare wurden an HM, SiM und WaS beobachtet. An HM auch ein ♀.
Populationsbiologie: vermutlich bivoltin
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Smerinthus ocellata

21 Individuen   14,3 % ♀-Rate

20 markiert   4 Wiederfänge

Wiederfang-Quote: niedrig! Alle Wiederfänge beziehen sich auf ein einziges ♂, das im Garten (WaS 1988) in 5 aufeinanderfolgenden Nächten gefangen wurde, das also von der Lichtwirkung gefangengehalten wurde. Stichprobe noch zu klein
Distanzen: 3
Larvalökologie: oligophag an Laubgehölzen, v.a. aus den Gattungen *Salix* und *Populus*. Die 150-300 m zwischen HM und dem Ruderal liegen im Bereich der normalen Dispersionsaktivität dieser Art. Im Ort tritt diese Art (wie auch die vorige) unregelmäßig auf; dies läßt den Schluß zu, daß Distanzen von 2 km (HM→SiN) nur selten geflogen werden. Vermutlich gibt es jedoch noch näherliegende Vorkommen dieser Art, die Obergrenze der "normalen" Flugaktivität (trivial movement) verringert sich dementsprechend.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Herse convolvuli (4 Individuen)

Distanzen: 4
Verbreitungsstrategie: r-Stratege, 1. Gruppe

Sphinx ligustri (4 Individuen)

Distanzen: 3-4
Larvalökologie: die Raupe lebt in erster Linie an verschiedenen Hecken und Büschen wie Liguster, Flieder u.s.w.. Das HM-Stück stammt also wahrscheinlich nicht aus dem Flughafengebiet und ist mindestens 800-1000 m geflogen.
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Hyloicus pinastri

89 Individuen   9,0 % ♀-Rate

86 markiert   1 Wiederfang

Wiederfang-Quote: niedrig; ein an WaN markiertes ♂ wurde an WNo nach 4 Tagen wiedergefunden. Die in dieser Zeit tatsächlich zurückgelegte Strecke ist vermutlich bedeutend größer als nur die Luftlinie von 50 m.
Distanzen: 2-4
Larvalökologie: auf Nadelbäume spezialisiert; die Distanz von ca. 1 km (Zuflug nach HM) kann in günstigen Jahren auch in größeren Stückzahlen geflogen werden. Der Einflug 1986 nach HM deckt sich mit einem ähnlichen Phänomen beim Eulenfalter *Panolis flammea*. Die als Kiefernschädlinge bekannten Schmetterlinge haben in diesem Jahr günstige Bestandsentwicklungen durchgemacht. Daraus resultiert offensichtlich eine vergrößerte Dispersionsaktivität aufgrund hoher Populationsdichte. 1989 wurde ein ♂ am Franzosenhölzl gefangen, die nächstgelegene Fichte befindet sich ca. 500 m entfernt.
Verbreitungsstrategie: r-Stratege, 5. Gruppe (in normalen Jahren); nach SCHWERDTFEGER (1978) unternimmt *H. pinastri* in seinem Verbreitungsgebiet und aus ihm hinaus Wanderungen.



Abb. 43b: Leucodonta bicoloria ♂ (Notodontidae; Mb, 12.6.87)



Abb. 43c: Deilephila porcellus ♂ (Sphingidae; Garten, 12.6.85)

Deilephila elpenor

10 Individuen	22,2 % ♀-Rate
9 markiert	kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein
Distanzen: 3-4 (nach HEYDEMANN, 1981, "0,5 - 10 km und mehr")
Larvalökologie: das HM-Stück könnte aus dem Ruderal stammen (*Epilobium*-Vorkommen) und ist mindestens 150-300 m geflogen. Neue *Epilobium*-Standorte sind meist bald mit Raupen besetzt.
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Deilephila porcellus

32 Individuen	32,1 % ♀-Rate
28 markiert	3 Wiederfänge

Wiederfang-Quote: hoch; bezogen auf den Standort HW 1987 sogar 16,7 %. Die Fang-Wiederfang-Intervalle betrugen bei den 3 ♂♂ durchschnittlich 3,0 Tage.
Distanzen: 2 (-3?)
Larvalökologie: an Arten der Gattungen *Galium* und *Epilobium*; die HM-Stücke flogen mindestens 150-300 m (Ruderal); diese Distanz scheint *D. porcellus* mehr oder weniger regelmäßig zurückzulegen. Ein Sich-Entfernen vom Verbreitungszentrum um 1000 m nach SiS konnte 1987 nicht nachgewiesen werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Macroglossum stellatarum

Diese Art soll bei den weiteren Auswertungen ausgeklammert bleiben, da sie bedingt durch die Tagaktivität in Lichtfallenfängen (mit Ausnahme eines Exemplars 1983) nicht nachzuweisen ist. Es handelt sich jedenfalls bekanntermaßen um einen Wanderfalter (r-Stratege, 1. Gruppe). Distanzen: 4

Hemaris fuciformis

Auch *H. fuciformis* soll aus den o.g. Gründen ausgeklammert werden, die Art gehört vermutlich einem intermediären Strategietyp der 5. Gruppe an. Distanzen: 2-3

THYATIRIDAE

Habrosyne pyritoides (126 Individuen)

Distanzen: 2-3
Larvalökologie: auf Brom- und Himbeere spezialisiert; die HM-Exemplare stammen vielleicht aus dem Ruderal (Brombeer-Vorkommen), sind also mindestens 150-300 m geflogen, was offensichtlich regelmäßig geschieht.
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Thyatira batis (41 Individuen)

Distanzen: 2
Larvalökologie: Raupenfutterpflanzen wie *H. pyritoides*, interessanterweise im Offenland (HM) noch nie nachgewiesen. Bemerkenswert ist auch der fehlende Nachweis an WNw, obwohl gleichzeitig in 100 bzw. 120 m Entfernung 11 Stücke beobachtet wurden.
Populationsbiologie: bivoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Tethea fluctuosa (6 Individuen)

Distanzen: 1-2
Larvalökologie: monophag an Birke. Bisher wurden keine biotopfremden Tiere festgestellt.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Tethea duplaris (96 Individuen)

Distanzen: 2-3
Larvalökologie: oligophag an Erle, Birke und Pappel; bisher wurden nur wenige biotopfremde Tiere festgestellt: Lediglich die beiden HM-Stücke müssen 800-1000 m zurückgelegt haben.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Tethea or (7 Individuen)

Distanzen: 2
Larvalökologie: auf *Salix* und *Populus* spec. spezialisiert; bisher wurden keine biotopfremden oder in den Siedlungsbereich einfliegenden Exemplare beobachtet.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Tethea ocularis

Distanzen: vermutlich 2-3
Larvalökologie: nur an Pappeln und Espe; das im Garten nachgewiesene Stück muß mindestens 200 m geflogen sein.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Polyploca flavicornis

32 Individuen   11,8 % ♀- Rate

16 markiert   1 Wiederfang

Wiederfang-Quote: vergleichsweise hoch, Stichprobe noch zu klein. Es wurde ein ♂ (WaN) nach 5 Tagen am gleichen Standort wiedergefangen.
Distanzen: 2
Larvalökologie: monophag an Birke (*Betula* spec.). 1989 war im Franzosenhölzl schon in einer Entfernung von 40 m, verglichen mit dem Fangergebnis am Waldrand ein Abundanzabfall auf die Hälfte festzustellen. Im Offenland wurde diese Art bisher nicht festgestellt. Die Distanz von 1 km liegt außerhalb der normalen Dispersionsaktivität.
Verbreitungsstrategie: K-Stratege, 6. Gruppe.

DREPANIDAE

Drepana falcataria (77 Individuen)

Distanzen: 2-3
Larvalökologie: Birke und Erle, vorwiegend an Büschen; diese Aussage, entnommen aus dem Werk KOCHs (1984) impliziert eine vermutlich erhöhte Dispersionsaktivität, da im Verlauf des Wachsens der Futterpflanzen desöfteren ein Standortwechsel zu Stellen auftreten sollte, wo Jungformen von *Alnus* bzw. *Betulus* spec. vorkommen. So wurden auch an HM 2 Exemplare festgestellt, die mindestens 1 km weit geflogen waren, eines davon war ein fertiles ♀, das zu einer Kolonisation fähig gewesen wäre. In beiden Fällen wurde der Ortswechsel von z.T. böigen Winden unterstützt. Beide Fälle traten in der 2. Generation auf. Der starke Häufigkeitsabfall von WaN nach WNo auf einer Strecke von nur 50 m spricht jedoch eher gegen eine höhere Austauschraten zwischen diesen beiden Standorten.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 4. Gruppe

Drepana lacertinaria (6 Individuen)

Distanzen: 1-2
Larvalökologie: ebenfalls nur an Birken und Erlen; bisher wurden keine biotopfremden Tiere festgestellt (abgesehen von vier 1989 in 40 m Entfernung zum Franzosenhölzl gefangenen Exemplaren).
Populationsbiologie: bivoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Drepana binaria

111 Individuen   46,2 % ♀- Rate

88 markiert   kein Wiederfang

Wiederfang-Quote: niedrig!
Distanzen: 3
Larvalökologie: als Raupe an Eiche, Rot-Buche und Erle gebunden. An HM wurden 3 Exemplare festgestellt, die mindestens 800-1000 m geflogen waren: 2 ♂♂ bei windstillem Wetter und 1 ♀ in einer stürmischen Nacht.
Populationsbiologie: bivoltin (einzelne Tiere einer 3. Generation); biotopfremde Stükke wurden auch in der 1 Generation gefunden.
Verbreitungsstrategie: r-Stratege, 3. Gruppe. Auch die starken Häufigkeitsschwankungen von Jahr zu Jahr und von Generation zu Generation deuten auf einen r-Strategen hin.

Drepana cultraria (92 Individuen)

Distanzen: 3
Larvalökologie: Raupenfutterpflanze: Buche, vermutlich auch Eiche. Die 3 HM-Stücke legten also mindestens 800-1000 m zurück, in einem Fall war der Zuflug durch böige Winde unterstützt, an den beiden anderen Tagen herrschte windstilles Wetter. Am Wasserwerk ist ein Häufigkeitsabfall auf 40 % in ca. 100 m Entfernung zum Habitat (WNw: Buchenwaldrand) zu erkennen.
Populationsbiologie: bivoltin, biotopfremde Tiere auch in der 1. Generation.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Cilix glaucata (3 Individuen)

Distanzen: vermutlich 1-2
Larvalökologie: an allen Fundorten wachsen in unmittelbarer Umgebung die Raupenfutterpflanzen.
Populationsbiologie: bivoltin
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe; der Falter zeichnet sich überdies durch einen vergleichsweise plumpen, mit den Spannern (*Geometridae*) vergleichbaren Flug aus.

SATURNIDAE

Eudia pavonia (3 Individuen)

Distanzen: 2 (♀♀); 3-4 (♂♂); 1989 wurden zwei ♂♂ bei einem raschen (ca. 20 km/h), geradlinigen Flug über mehrere 100 Meter beobachtet.
Larvalökologie: das HM-Stück (fertiles ♀) stammt wohl aus dem Ruderal (150-300 m), dort findet sich das nächstgelegene Vorkommen von Raupenfutterpflanzen dieser Art (z.B. Weiden).
Populationsbiologie: am Licht wurden nur ♀♀ festgestellt. Die ♂♂ fliegen tagsüber.
Verbreitungsstrategie: K-Stratege, 5. Gruppe; durch die große Agilität der ♂♂ wird eine gute Gendurchmischung erreicht.

LASIOCAMPIDAE

Malacosoma neustria (14 Individuen)

Distanzen: 2-3
Larvalökologie: verschiedene Laubbäume, dementsprechend im Offenland nie beobachtet
Verbreitungsstrategie: r-Stratege, 5. Gruppe

Poecilocampa populi

116 Individuen 13,8 % ♀- Rate

98 markiert kein Wiederfang

Wiederfang-Quote: niedrig! An HO wurde z.B. nach 46 in einer Nacht markierten Stücken bei der Probeentnahme 2 Tage später kein einziges markiertes Exemplar mehr nachgewiesen.
Distanzen: 3
Larvalökologie: durch die Raupenfutterpflanze an Laubhölzer gebunden. Das an HM gefangene Stück stammt zumindest aus dem Ruderal (150-300 m). Die Strecke von 1 km ins Flughafeninnere wird jedoch von den am Flughafenrand zahlreich vorhandenen Exemplaren dieser Art nicht regelmäßig geflogen.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Pachygastria trifolii

117 Individuen 30,7 % ♀- Rate*

109 markiert kein Wiederfang

* Ein Problem bei dieser Art scheint zu sein, daß nur die ♀♀ ans Licht kommen, die gefangenen ♂♂ erklären sich durch indirekte Anlockung durch die Sexualpheromone von bereits gefangenen ♀♀ in der Falle. Darüber hinaus ist eine hohe Mortalität der ♀♀, die oft unmittelbar nach der Eiablage entkräftet sterben, zu veranschlagen.



Abb. 43d: Eudia pavonia ♀ (Saturnidae; WaN, 22.4.88). Die im Tageslicht fliegenden ♂♂ sind mit der Methodik des Lichtfangs nicht nachzuweisen.

Tab 61: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Pachygastria trifolii.*

1987	SIEDLUNG		Garten	WALD			HALBTROK-KENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	–	–	–	–	–	–	4	11	46	–	61
♂♂	–	–	–	–	–	–	3	7	37	–	47
♀♀	–	–	–	–	–	–	1	4	8	–	13
Mark.	–	–	–	–	–	–	4	11	43	–	58
W.f.	–	–	–	–	–	–	–	–	–	–	–

1988	WALD Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"	
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We
Σ par.	1	–	3	–	–	8	12	32	–	–
♂♂	1	–	–	–	–	4	5	22	–	–
♀♀	–	–	3	–	–	4	7	9	–	–
Mark.	1	–	3	–	–	8	11	28	–	–
W.f.	–	–	–	–	–	–	–	–	–	–

Wiederfang-Quote: sehr gering, trotz aller methodischer Bedenken (s.o.). Die Flugzeit fällt der Hauptfangperiode im Offenland zusammen, bei Ortstreue hätten Wiederfänge stattfinden müssen.
Distanzen: 2-3. Außerhalb des Habitats nur selten anzutreffen: Keine Nachweise in 400 m (SiS) und 800 m (SiM) Entfernung. Schon am Rand (HO) eine deutliche Abnahme der Abundanz. Das Ex. im Garten (SiN, allerdings ein ♂), sowie die (Trittstein-)Besiedelung des Wasserwerks lassen erkennen, daß in Mehrjahresintervallen ausnahmsweise einmal 1 km bewältigt wird (über biotopfremdes Gebiet).
Larvalökologie: *P. trifolii* gehört zu den Arten, die gut mit der Schafbeweidung zurecht kommen: Die Raupen leben zwar oberirdisch, sie sind aber durch ihre auffällige Färbung gut sichtbar und werden gemieden.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Macrothylatia rubi (11 Individuen)

Distanzen: 2-3
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Philudoria potatoria (8 Individuen)

Distanzen: 3; die ♂♂ WaS 1988/89 sind wohl zugeflogen. Die Population am Wasserwerk ist als positives Resultat eines Kolonisationsversuchs innerhalb der letzten 10 Jahre zu verstehen.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe.

Cosmotriche lunigera

Distanzen: vermutlich 2
Larvalökologie: an Nadelbäume gebunden; bisher keine biotopfremden Tiere
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Dendrolimus pini (3 Individuen)

Distanzen: vermutlich innerhalb des Habitats 3, außerhalb 2
Larvalökologie: die Raupe lebt an Kiefer, Fichte und Weiß-Tanne werden nur ausnahmsweise angenommen; bisher keine biotopfremden Tiere beobachtet
Populationsbiologie: eine große potentielle Populations-Wachstumsrate führt zu den gefürchteten gelegentlichen Massenvermehrungen (vergleiche z.B. ODUM & REICHHOLF, 1980).
Verbreitungsstrategie: r-Stratege, 5. Gruppe

PSYCHIDAE

Diese interessante Familie soll in der weiteren Auswertung ausgeklammert werden, da ihre Vertreter im Gebiet (mit Ausnahme von *Sterrhopteryx fusca*) mit Lichtfängen nicht nachgewiesen werden können. Die Arten dieser Gruppe haben bis auf wenige Ausnahmen flügellose ♀♀, so daß den oft tagaktiven ♂♂ (meist hohe Dispersionsaktivitäten) eine besondere Rolle für die Gendurchmischung der Populationen zukommt. Dies entfällt bei einigen parthenogenetischen Arten (im Gebiet z. B. *Dahlica triquetrella*).
Für die Verbreitungsstrategie spielen vermutlich die Larvalstadien eine größere Rolle: Die Eier werden oft direkt am Sack des ♀ abgelegt, der in vielen Fällen an erhöhten Standorten befestigt wird. Die schlüpfenden Eiräupchen "seilen sich ab" und können durch Winde oder durch Vögel, die im Flug den Faden und damit das Räupchen mitreißen, verbreitet werden.
Weiterhin zeichnen sich bisweilen die erwachsenen Raupen durch größere Mobilität aus. Die Arten sind wohl als K-Strategen der 6. Gruppe (zumindest, was die ♀♀ betrifft) zu bezeichnen.
In einem ca. 1 ha großen Kiefernwäldchen in der Nähe des Mallertshofer Holzes fanden sich Säcke von *Psyche casta, Talaeporia tubulosa, Bacotia sepium* und *Narycia monilifera*. Der Biotop ist stark isoliert und in allen Richtungen von mindestens 500 m intensiv genutztem Ackerland umgeben (seit über 15 Jahren). Dennoch können die genannten Arten offensichtlich stabile Populationen unterhalten.

AEGERIIDAE

Auch diese Familie soll in der weiteren Auswertung wegen der geringen Erfaßbarkeit durch die angewandte Methodik unberücksichtigt bleiben.

COSSIDAE

Cossus cossus (1 Individuum)

Distanzen: vermutlich 2-3
Larvalökologie: zur Larvalentwicklung werden 2-4 Jahre benötigt; dies erlaubt *C. cossus* keine Strategie, die eine rasche Wachstumsrate der Populationen beinhalten würde. Da befallene Bäume des öfteren absterben, muß in der Folgegeneration das Aufsuchen neuer Futterquellen vorprogrammiert sein, die Polyphagie gewährleistet dies jedoch. Es werden ältere Bäume bevorzugt.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Zeuzera pyrina (2 Individuen)

Distanzen: vermutlich 2-3
Larvalökologie: zur Larvalentwicklung werden 2-3 Jahre benötigt, siehe Bemerkungen zu *C. cossus*. *Z. pyrina* zeigt eine von voriger Art etwas unterschiedene Einnischung: Es werden jüngere Bäume bevorzugt.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

HEPIALIDAE

Hepialus humuli (20 Individuen)

Distanzen: 2-3, im trockeneren Offenland (HM, auch HW) noch nie beobachtet
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Hepialus sylvina

197 Individuen 22,7 % ♀- Rate

166 markiert 3 Wiederfänge

Tab 62: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Hepialus sylvina.*

1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	6	-	7	8	2	5	10	-	17	-	54
Σ zus.	-	1	1	1	-	-	-	-	-	-	3
♂♂	3	-	7	7	1	2	6	-	8	-	34
♀♀	2	1	1	2	1	3	3	-	9	-	22
Mark.	4	-	8	8	2	5	9	-	16	-	52
W.f.	-	-	-	-	-	-	-	-	-	-	-

1988	WALD Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	20	15	11	3	9	23	2	39	2	1	125
Σ zus.	-	15	-	-	-	-	-	-	-	-	15
♂♂	13	24	6	3	7	14	2	30	-	-	99
♀♀	1	2	4	-	1	6	-	3	-	-	17
Mark.	14	26	10	3	8	20	2	31	-	-	114
W.f.	-	3	-	-	-	-	-	-	-	-	3

Wiederfang-Quote: niedrig: Die 3 wiedergefangenen ♂♂ beziehen sich auf 2 Rückfunde am Standort WaS 1988 nach 1-Tages-Intervallen und nur auf einen "echten" Wiederfang am selben Ort nach 2 Tagen (in der dazwischenliegenden Nacht erfolgte kein Lichtfang).
Distanzen: 3-4
Larvalökologie: stark polyphag
Populationsbiologie: proterandrisch; im Garten fällt ein erhöhter ♂♂-Anteil auf, die Art ist jedoch auch hier bodenständig (Beobachtung eines schlüpfenden Exemplars).
An HM ist der Häufigkeitswechsel 1986/1987 bemerkenswert. Auch diese Unstetigkeit kann als Hinweis auf eine hohe Dynamik in der Verbreitungsstrategie dieser Art gewertet werden.
Verbreitungsstrategie: r-Stratege, 2. Gruppe

Hepialus hecta (2 Individuen, in der Dämmerung einige weitere)

Distanzen: 2-3
Populationsbiologie: am Würmkanal (Au) wurden am späten Abend ca. 10 Exemplare beim Ausschwärmen beobachtet. Der Flug diente offensichtlich zum Auffinden der Geschlechtspartner. Es wurde eine Kopula registriert. Die Aktivitäten beschränkten sich auf den Waldrand, wohingegen im Waldesinneren und auf dem freien Feld kein Exemplar gefunden werden konnte.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

NOCTUIDAE

NOCTUINAE

Euxoa tritici (5 Individuen)

Distanzen: 3; das Exemplar im Ort war vielleicht vom Verbreitungszentrum (Halbtrockenrasen) zugeflogen (ca. 1 km).
Verbreitungsstrategien: r-Stratege, 5. Gruppe

Euxoa obelisca (3 Individuen)

Distanzen: 3; die Exemplare im Ort waren vielleicht vom Verbreitungszentrum (Halbtrockenrasen) zugeflogen (ca. 1 km).
Verbreitungsstrategien: r-Stratege, 5. Gruppe

Euxoa nigricans (2 Individuen)

Distanzen: vermutlich 3; Verhältnisse wohl wie bei den vorhergehenden Arten.
Verbreitungsstrategien: vermutlich r-Stratege, 5. Gruppe

Euxoa aquilina (30 Individuen)

Distanzen: 3. Von den Verbreitungszentren (Halbtrockenrasen) her zufliegende Exemplare gelegentlich im Ort (ca. 1 km), ein relativ starker Vorstoß 1983.
Verbreitungsstrategien: r-Stratege, 5. Gruppe

Scotia segetum (18 Individuen)

Distanzen: 3-4
Larvalökologie: in früheren Zeiten oft an Getreide schädlich, durch Pestizideinsatz nahmen die Bestände drastisch ab. Halbtrockenrasen scheinen im Untersuchungsgebiet Refugialstandorte darzustellen.
Verbreitungsstrategien: r-Stratege, 1. Gruppe

Scotia clavis

siehe Fernwiederfänge (8.2.) und Versetzexperiment (8.4.)

582 Individuen   17,8 % ♀- Rate

546 markiert   61 Wiederfänge

Tab 63: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Scotia clavis.*

1987	SIEDLUNG		Garten		WALD		HALBTROKKENRASEN			"DACH, MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	2	27	30	17	5	9	35	13	43	1	170
Σ zus.	-	-	-	26	-	3	21	8	38	-	96
♂♂	1	19	23	27	3	7	47	21	48	-	196
♀♀	1	8	7	13	2	4	8	-	13	1	57
Mark.	2	26	29	38	4	11	55	20	53	1	239
W.f.	(1)	1	2	5	-	-	1	-	5	-	15

1988	Garten		WALD Wasserwerk			HALBTROKKENRASEN			"DACH, MOOS"	
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We
Σ par.	27	62	14	20	7	32	32	45	1	-
Σ zus.	-	76	-	-	-	-	-	-	-	-
♂♂	25	120	7	19	5	26	28	41	-	-
♀♀	2	18	6	1	2	6	4	4	1	-
Mark.	25	137	12	20	7	30	31	44	1	-
W.f.	2	38	-	-	-	3	-	3	-	-

Wiederfang-Quote: standortabhängig: Im Garten, HO und HW mit 3-10% Wiederfängen, die nicht auf Gefangenschaft durch die Lichtwirkung beruhen, relativ hoch. Garten 1987 bei den 7 ♂♂ eine mittlere Verweildauer von 2,7 Tagen. HO und HW bei den Ortswiederfängen (9 ♂♂, 1 Drittfang) eine mittlere Verweildauer von 5,0 Tagen, 3 Exemplare nach 14, 9 bzw. 8 Tagen!
Im Wasserwerk und HM niedrige Wiederfang-Quote, hier wohl erhöhte Dispersionsaktivitäten.
Distanzen: 2-4; im Moos tauchten bisher nur sehr wenige Stücke auf. In feuchteres Gelände hinein scheint die Mobilität dieser Art drastisch reduziert zu sein.
Populationsbiologie: proterandrisch; abgesehen von den beiden im Versetzexperiment behandelten Stücken wurden keine ♀♀ wiedergefangen! Die Ursache liegt vielleicht in einer höheren Mobilität der ♀♀ (siehe *Sc. exclamationis*).
Verbreitungsstrategien: intermediärer Typ, 3. Gruppe; im Vergleich zu *S. exclamationis* weniger expansiv, was als Erklärung für das in Bayern etwas lokalere Vorkommen (!) in Frage kommt. An anderen südbayerischen Standorten ist die Art bisweilen recht selten.

Scotia exclamationis

siehe Versetzexperiment (8.4.)

679 Individuen 34,2 % ♀- Rate

634 markiert 23 Wiederfänge

Tab 64: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Scotia exclamationis*.

1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	2	37	29	13	9	31	46	31	60	-	258
Σ zus.	-	1	6	14	-	21	7	1	17	-	67
♂♂	-	21	25	15	6	29	34	25	51	-	206
♀♀	2	15	8	9	2	17	14	5	13	-	85
Mark.	2	35	32	23	8	45	47	30	63	-	285
W.f.	-	-	1	2	-	-	3	-	3	-	9

1988	WALD Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	31	33	39	4	29	62	45	69	-	4	316
Σ zus.	-	38	-	-	-	-	-	-	-	-	38
♂♂	18	34	17	2	17	33	38	54	-	2	215
♀♀	11	35	22	2	12	29	7	14	-	2	134
Mark.	29	69	39	4	29	62	45	68	-	4	349
W.f.	1	13	-	-	-	-	-	-	-	-	14

Wiederfang-Quote: im Vergleich mit der vorigen Art deutlich niedriger; alle Wiederfänge, soweit sie nicht im Versetzexperiment behandelt wurden, erfolgten nach einem Intervall von 2-3 Tagen! Im Gegensatz zum Garten wurden an den anderen Standorten keine ♀♀ wiedergefangen. Da sich die Mortalität wohl auf einem ähnlichen Niveau bewegt wie bei den ♂♂ (siehe Versetzexperiment), scheinen hier die ♀♀ mobiler als die ♂♂ zu sein!

Distanzen: 3-4; z.T. hohe Nacht-zu-Nacht-Fluktuationen: 8 der 9 WaM-Stücke wurden in einer Nacht gefangen; ein solch schwarmartiges Auftreten läßt vermuten, daß die Art hier nur zugeflogen war.
Am Wasserwerk zeigt sich im Gegensatz zu *S. clavis* eine Häufigkeitsverteilung wie bei den hochmobilen Arten *Ochropleura plecta* und *Amathes c-nigrum*. Man könnte darin entlang der Waldränder ziehende Exemplare vermuten.

Populationsbiologie: proterandrisch; die ♀♀-Rate sinkt mit zunehmendem Offenlandcharakter und ist an HM und HW relativ niedrig.

Verbreitungsstrategie: r-Stratege, 1. Gruppe

Scotia ipsilon

261 Individuen 44,1 % ♀- Rate

215 markiert 11 Wiederfänge

Tab 65: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Scotia ipsilon*.

1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	4	86	8	21	3	4	11	6	25	1	169
Σ zus.	-	8	-	8	-	1	1	-	-	-	18
♂♂	1	46	5	11	1	2	6	3	11	-	86
♀♀	3	26	3	13	1	2	6	3	9	1	67
Mark.	4	70	8	24	2	3	12	6	19	1	149
W.f.	-	-	-	-	-	-	-	-	-	-	-

1988	WALD Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	3	15	7	4	5	2	7	10	2	-	55
Σ zus.	-	19	-	-	-	-	-	-	-	-	19
♂♂	2	15	5	1	2	1	5	6	-	-	37
♀♀	1	15	2	3	3	1	1	4	-	-	30
Mark.	3	30	7	4	4	2	6	10	-	-	66
W.f.	-	11	-	-	-	-	-	-	-	-	11

Wiederfang-Quote: sehr niedrig, alle Wiederfänge erfolgten nach 1-Tages-Intervallen und sind somit kein Hinweis auf Ortstreue! Wie auch bei den anderen Wanderfaltern erwies sich die mark-recapture-Methode in einer solchen "Nullprobe" als gut brauchbar.
Je ein ♂ und ein ♀ konnten beim täglichen Fang WaS 1988 3 Tage lang festgehalten werden.

Distanzen: 4

Populationsbiologie: oft, jedoch nicht immer konnte Proterandrie beobachtet werden (♀♀ ab September häufiger).

Verbreitungsstrategie: r-Stratege, 1. Gruppe; die Art ist an den typischen "Wanderfalterstandorten" (SiM, HW, entlang der Hecken im Dachauer Moos) besonders häufig, vermutlich handelt es sich um bevorzugte "Straßen", wie sie bei *Autographa gamma* direkt (tagsüber) beobachtet wurden.

Ochropleura plecta

siehe Fernwiederfänge (8.2.) und verringerte Fallendistanzen (8.3.)

1803 Individuen 49,8 % ♀- Rate

1578 markiert 59 Wiederfänge

Tab. 66: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Ochropleura plecta.*

1987 1. Gen.	SIEDLUNG SiS	SiM	Garten SiN	WaS	WALD WaM	WaN	HALBTROK-KENRASEN HO	HM	HW	"DACH. MOOS" Mb	Σ
Σ par.	1	-	1	2	-	3	11	5	6	13	42
Σ zus.	-	-	1	3	-	6	-	-	1	-	11
♂♂	1	-	-	3	-	8	6	2	5	6	31
♀♀	-	-	2	2	-	-	3	3	1	4	15
Mark.	1	-	1	4	-	8	9	5	6	10	44
W.f.	-	-	-	-	-	-	-	-	-	-	-

1987 2. Gen.	SIEDLUNG SiS	SiM	Garten SiN	WaS	WALD WaM	WaN	HALBTROK-KENRASEN HO	HM	HW	"DACH. MOOS" Mb	Σ
Σ par.	1	2	13	15	3	45	26	32	112	11	2[illegible]
Σ zus.	-	21	7	-	-	-	3	2	-	-	[illegible]
♂♂	1	12	11	2	-	24	16	10	34	3	1[illegible]
♀♀	-	26	9	11	3	20	12	24	72	7	1[illegible]
Mark.	1	37	19	13	3	41	27	33	101	9	2[illegible]
W.f.	-	-	1	1	-	-	-	-	-	-	[illegible]

1988 1. Gen.	Garten SiN	WaS	WALD Wasserwerk WaN	WNw	WNo	HALBTROK-KENRASEN HO	HM	HW	"DACH. MOOS" Au	We	Σ
Σ par.	4	13	29	8	28	32	9	29	8	3	163
Σ zus.	-	9	-	-	-	-	-	-	-	-	9
♂♂	2	14	18	7	21	21	7	19	6	2	117
♀♀	1	6	8	1	5	9	2	7	2	1	42
Mark.	3	20	26	8	26	30	8	25	8	3	167
W.f.	-	4	-	-	-	-	1	-	-	-	5

1988 2. Gen.	Garten SiN	WaS	WALD Wasserwerk WaN	WNw	WNo	HALBTROK-KENRASEN HO	HM	HW	"DACH. MOOS" Au	We	Σ
Σ par.	100	188	233	49	96	180	40	126	25	10	10[illegible]
Σ zus.	-	220	-	-	-	-	-	-	-	-	2[illegible]
♂♂	56	152	137	14	37	85	17	68	2	2	5[illegible]
♀♀	38	220	86	30	42	87	22	53	2	2	5[illegible]
Mark.	92	359	206	42	72	158	37	119	4	4	10[illegible]
W.f.	1	48	1	1	-	1	-	-	-	-	[illegible]

Wiederfang-Quote: sehr niedrig bei sehr kurzen Verweildauern: Im Garten erfolgten, abgesehen von 5 Wiederfängen nach 2 Tagen alle Rückfänge nach 1-Tages-Intervallen. Die niedrige mittlere Verweildauer von 1,22 Tagen ist schon durch festgehaltene Exemplare überhöht.
Die ♀-Rate liegt bei den Erstwiederfängen bei ca. 50 %. Bei den durch die Lichtwirkung über mehrere Tage festgehaltenen Stücken (Mehrfachwiederfänge) und bei den "echten" Ortswiederfängen (Fangnacht-Pausen dazwischen) zeigt sich ein stark erhöhter ♀-Anteil: 80 %. Auch der HO-Wiederfang 1988 nach 3 Tagen (das längste festgestellte Intervall!) war ein ♀.
In beiden Generationen hohe Dispersionsaktivitäten!

Distanzen: 4

Larvalökologie: die Raupen finden wohl überall eine Lebensgrundlage.

Populationsbiologie: bivoltin, die ♀-Rate schwankt in Ort und Zeit bisweilen beträchtlich: Im Wasserwerk (WaN) waren am 10.8.88 noch 65 %, am 12.8.88 nur noch 9 % ♀♀ zu beobachten. Dagegen war am 2.8.88) an zwei nur 50 m voneinender entfernten Standorten (WaN, WNo) eine ♀-Rate von 37,5 % bzw. 73 % festzustellen. Dies und eine Reihe anderer Beobachtungen rechtfertigen die Hypothese von geschlechtspolarisierten Schwärmen.
Eine "Populationsgrößen-Berechnung" im Garten vom 1.8. auf den 2.8.88 (40 bzw. 47 Individuen, 6 Wiederfänge) ergäbe eine "Populationsgröße" von 313 Individuen im Einzugsbereich der Lichtfalle, die hohe Mobilität dieser Art stört derartige Berechnungen jedoch gewaltig.

Verbreitungsstrategie: r-Stratege, 2. Gruppe; auch das besonders häufige Auftreten in Wanderfalternächten und das Häufigkeitsmuster mit Peaks an denselben Standorten wie bei den als Wanderfalter bekannten Arten sind bemerkenswert und wohl als weiterer Hinweis auf die hohe Mobilität dieser Art zu verstehen. Es handelt sich jedoch nicht um einen Wanderfalter (siehe EITSCHBERGER & STEINIGER, 1980).

Eugnorisma depuncta

Distanzen: vermutlich 2

Larvalökologie: die Raupenfutterpflanzen sind überall verfügbar

Verbreitungsstrategie: vermutlich K-Stratege, 5. Gruppe; einen Hinweis darauf gibt das lokale Vorkommen bzw. die Seltenheit dieser Art.

Rhyacia lucipeta (1 Individuum)

Distanzen: 4, das Stück ist vermutlich aus den Alpen zugeflogen!

Verbreitungsstrategie: r-Stratege, 1. Gruppe

Rhyacia simulans (1 Individuum)

Distanzen: 4 , wie *Rh. lucipeta*

Verbreitungsstrategie: r-Stratege, 1. Gruppe

Noctua pronuba

siehe Fernwiederfänge (8.2.), verringerte Fallendistanzen (8.3.) und Versetzexperiment (8.4.)

1675 Individuen 44,2 % ♀-Rate

1457 Markiert 167 Wiederfänge

Tab. 67: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Noctua pronuba.*

1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	9	21	8	74	4	23	40	26	54	-	259
Σ zus.	-	17	8	5	-	3	5	-	-	-	38
♂♂	4	28	11	50	1	18	28	10	34	-	184
♀♀	5	6	1	21	3	2	10	11	16	-	75
Mark.	9	34	12	71	4	20	37	21	49	-	257
W.f.	-	-	2	1	-	-	-	-	-	-	3

1988	WALD Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	48	448	75	94	42	123	13	95	35	4	977
Σ zus.	-	401	-	-	-	-	-	-	-	-	401
♂♂	26	403	41	47	24	60	3	37	9	-	640
♀♀	14	360	25	43	11	63	9	60	3	-	578
Mark.	40	755	64	87	34	113	11	84	12	-	1200
W.f.	-	162	-	1	1	-	-	-	-	-	164

Wiederfang-Quote: sehr niedrig (siehe o.g. Experimente); die Wiederfänge 1987 im Garten erfolgten nach 2 (♀), 2 (♂) und 4 (♀) Tagen. Die vereinzelten Ortswiederfänge, die nicht auf ein Festgehalten-Werden durch die Lichtwirkung zurückzuführen sind, deuten auf Einzelexemplare hin, die ortstreuer werden (v.a. ♀♀).
Distanzen: 4
Populationsbiologie: die Sommerruhe, die diese Art einlegt ist nach MEINECKE (1984) ähnlich wie bei den bivoltinen Arten ein Hinweis auf hohe Dispersionsaktivitäten. Proterandrisch.
Verbreitungsstrategie: r-Stratege, 1. Gruppe

Noctua comes (112 Individuen)

Distanzen: 4; im Verbreitungsmuster und in den Flugnächten relativ stark mit *Noctua pronuba* korreliert.
Verbreitungsstrategie: r-Stratege, 3. Gruppe; GYULAI & VARGA (1974) berichten von gerichteten Bewegungen innerhalb des Areals dieser Art.

Noctua fimbriata (43 Individuen)

Distanzen: 3-4
Larvalökologie: entsprechend der Polyphagie der Raupen sind auch die Imagines mehr oder weniger überall zu finden.
Verbreitungsstrategie: r-Stratege, 1. Gruppe

Noctua janthina (35 Individuen)

Distanzen: 3-4
Larvalökologie: Siehe Bemerkungen zur vorigen Art
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Spaelotis ravida (3 Individuen)

Distanzen: 4
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Graphiphora augur (3 Individuen)

Distanzen: vermutlich 3
Verbreitungsstrategie: vermutlich r-Stratege, 3. Gruppe

Paradiarsia punicea (10 Individuen)

Distanzen: 2; schon 400 m nördlich des Birkets ("Moos 1985") konnte kein Exemplar mehr nachgewiesen werden.
Verbreitungsstrategie: K-Stratege, 5. Gruppe

Diarsia mendica (76 Individuen)

Distanzen: 2
Larvalökologie: obwohl die Raupen an "niedrigen Pflanzen" leben, ist *D. mendica* ziemlich stark habitatgebunden (Wald). Die polarisierten Zahlenverhältnisse WaS→SiN sowie WNw→WaN bzw. →WNo zeigen, daß schon in 30-100 m Entfernung vom Habitat deutliche Häufigkeitsverluste feststellbar sind.
Verbreitungsstrategie: K-Stratege, 5. Gruppe

Diarsia brunnea (204 Individuen)

Distanzen: 2
Larvalökologie: siehe Bemerkungen zu *Diarsia mendica*
Verbreitungsstrategie: K-Stratege, 5. Gruppe

Diarsia rubi (22 Individuen)

Distanzen: 2-3; an HM nie beobachtet, dagegen war *D. rubi* 1989 am Franzosenhölzl eher im Freien zu finden: Zehn Exemplaren am Waldrand standen neunzehn in einer Entfernung von 40 m gegenüber.
Populationsbiologie: bivoltin
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Amathes c-nigrum

siehe verringerte Fallendistanzen (8.3.) und Versetzexperiment (8.4.)

1460 Individuen 32,9 % ♀- Rate

1255 markiert 54 Wiederfänge

Tab. 68: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Amathes c-nigrum.*

1987	SIEDLUNG		Garten		WALD		HALBTROCKENRASEN			"DACH. MOOS"	Σ
1. Gen.	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	-	-	-	-	1	4	4	-	8	-	17
Σ zus.	-	-	-	-	-	2	-	-	-	-	2
♂♂	-	-	-	-	1	2	4	-	6	-	13
♀♀	-	-	-	-	-	2	-	-	1	-	3
Mark.	-	-	-	-	1	3	4	-	7	-	15
W.f.	-	-	-	-	-	-	-	-	1	-	1

1987	SIEDLUNG		Garten		WALD		HALBTROCKENRASEN			"DACH. MOOS"	Σ
2. Gen.	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	-	67	8	9	4	21	24	21	84	4	24[illegible]
Σ zus.	-	15	1	6	-	3	-	-	2	-	2[illegible]
♂♂	-	46	6	8	3	8	14	13	46	1	14[illegible]
♀♀	-	34	3	5	1	10	8	8	26	2	9[illegible]
Mark.	-	79	9	12	4	17	22	20	71	3	23[illegible]
W.f.	-	-	-	-	-	-	-	-	-	-	[illegible]

1988	Garten		WALD Wasserwerk			HALBTROCKENRASEN			"DACH. MOOS"		Σ
1. Gen.	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	2	1	13	2	9	11	4	29	1	1	73
Σ zus.	-	1	-	-	-	-	-	-	-	-	1
♂♂	2	1	5	1	5	9	4	22	-	1	50
♀♀	-	1	8	1	4	1	-	4	1	-	20
Mark.	2	2	13	2	9	10	4	26	1	1	70
W.f.	-	2	-	-	-	-	-	-	-	-	2

1988	Garten		WALD Wasserwerk			HALBTROCKENRASEN			"DACH. MOOS"		Σ
2. Gen.	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	46	131	167	30	198	128	68	147	26	8	94[illegible]
Σ zus.	-	151	-	-	-	-	-	-	-	-	15[illegible]
♂♂	24	139	97	19	122	87	52	102	-	-	64[illegible]
♀♀	12	113	50	7	42	29	11	33	-	-	29[illegible]
Mark.	36	250	147	26	164	112	63	135	-	-	93[illegible]
W.f.	-	50	-	-	1	-	-	-	-	-	5[illegible]

Wiederfang-Quote: ist als niedrig einzustufen! Nur 2 "reguläre" Wiederfänge (mit dazwischenliegender fangfreier Nacht) bei über 1000 Markierungen: HW 1987 nach 3 Tagen und WNo 1988 nach 2 Tagen (jeweils ein ♂).
Im Garten überwiegen sehr stark die Rückfänge nach 1-Tages-Intervallen, aus dem Rahmen fällt lediglich ein ♀ nach 4 Tagen. Die mittlere Verweilzeit betrug hier 1988 nur 1,21 Tage.
Die ♀-Rate in den Wiederfängen entspricht ungefähr der in den Erstfängen festgestellten.
Distanzen: 4; in der ersten Generation wohl nur 3-4: In Jahren mit relativ ungünstiger Bestandsentwicklung (z.B. 1987) zeigt sich ein Fehlen in der 1. Generation an suboptimalen Standorten, nämlich Siedlung, HM und im Dachauer Moos. Die Distanzen von 1 km (HW→HM) und 1,4 km (WaN→WaS) scheinen, zumindest bei solchen Konstellationen für die Individuen der 1. Generation nicht im Rahmen der normalen Dispersionsaktivitäten zu liegen. Das Häufigkeitsmuster HW › HO + WaN ›› HM, Siedlung, Moos und Wald (WaM, WNw) scheint in der 1. Generation von Jahr zu Jahr konstant zu sein.
In der zweiten Generation kommt es dann zu einem Einflug an solche "suboptimale" Standorte, besonders deulich war dies 1987 an SiM mitzuverfolgen. Jedoch werden offenbar nicht alle Standorte gleichermaßen überschwemmt, was die signifikante Häufigkeitsdifferenz zwischen SiM und SiS bei einer Distanz von nur 400 m veranschaulicht. Es werden "Zugstraßen" bevorzugt. Das im Netz der Fangstellen festgestellte Häufigkeitsmuster entspricht dem charakteristischen Wanderfalterbild.
Larvalökologie: die Art findet wohl überall eine Lebensgrundlage
Populationsbiologie: bivoltin; die zum Teil sehr starken Nacht-zu-Nacht-Fluktuationen deuten auf einen Flug in Trupps oder zumindest auf besondere flugstimulierende Faktoren hin. Diese Faktoren sollten eine gewisse Spezifität aufweisen, da sich in mehreren Fällen "Häufigkeitstäler" zwischen 2 Aktivitätsmaxima genau in solchen Nächten befanden, in denen andere Arten recht gut flogen und öfters sehr gute Lichtfallen-Ausbeuten erzielt wurden.

Verbreitungsstrategie: r-Stratege, 1. Gruppe; *Amathes c-nigrum* kann jedoch im Gegensatz zu manchen anderen Arten aus der Gruppe der typischen Wanderfalter unseren Winter gut überstehen. Die starken Fluktuationen von Generation zu Generation sind für eine r-Strategie typisch.

Amathes ditrapezium

siehe verringerte Fallendistanzen (8.3.)

512 Individuen 29,5 % ♀-Rate

456 markiert 22 Wiederfänge

Tab. 69: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Amathes ditrapezium.*

1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	8	6	9	16	3	39	18	6	3	24	132
Σ zus.	-	-	3	6	-	4	7	2	2	-	24
♂♂	7	5	6	11	-	21	17	4	3	14	88
♀♀	1	-	4	8	3	14	6	4	2	4	46
Mark.	8	5	10	19	3	35	23	8	3	16	130
W.f.	-	-	-	1	-	1	-	-	-	-	2

1988	WALD Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	19	53	59	31	41	28	4	4	32	24	294
Σ zus.	-	62	-	-	-	-	-	-	-	-	62
♂♂	16	77	34	17	30	24	1	4	20	17	240
♀♀	2	26	23	13	10	2	3	-	6	6	91
Mark.	17	102	57	29	38	26	4	4	26	23	326
W.f.	1	12	1	1	4	-	-	-	-	1	20

Wiederfang-Quote: standortabhängig: Im Wasserwerk relativ hoch, sonst eher niedrig. Die 1987 rückgefangenen Tiere waren 2 ♂♂ nach 2 Tagen. 1988 errechnete sich für die Wiederfänge im Garten eine mittlere Verweildauer von 1,64 Tagen, wobei es sich bei nur 2 Ausnahmen um Intervalle von 1 Tag handelte: 1 ♂ nach 2 Tagen und ein ♀, an WaS markiert und nach 5 Tagen 30 m entfernt an SiN festgestellt.
Die ♀♀ sind im Garten in den Wiederfängen deutlich überrepräsentiert!
Ein Festhalten durch die direkte Lichteinwirkung bei täglichem Fang findet in weit geringerem Ausmaß statt als bei folgender Art. Die Proportionen Fang/Wiederfang/Mehrfachfänge liegen ähnlich wie bei *Noctua pronuba*, nur etwas niedriger.
Die Fluchtdisposition ist deutlich größer als bei der ähnlichen Art *A. triangulum.*
Distanzen: 2-3 (-4?); im Wasserwerk ortstreuer, sonst relativ mobil.
Populationsbiologie: proterandrisch;
Verbreitungsstrategie: intermediärer Typ, 2. Gruppe

Amathes triangulum

siehe Fernwiederfänge (8.2.), verringerte Fallendistanzen (8.3.) und Rückschlüsse aus den Ortswiederfängen (8.5.)

996 Individuen 24,0 % ♀-Rate

919 markiert 122 Wiederfänge

Tab. 70: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Amathes triangulum.*

1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	8	12	8	31	3	53	37	5	11	6	174
Σ zus.	-	-	2	16	-	8	14	1	4	-	45
♂♂	4	6	6	33	2	38	38	5	6	3	141
♀♀	4	4	4	8	1	14	13	-	5	1	54
Mark.	8	10	10	41	3	52	50	5	11	4	194
W.f.	-	-	-	-	-	-	-	-	-	-	-

1988	WALD Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	57	200	84	42	79	44	2	12	17	9	546
Σ zus.	-	231	-	-	-	-	-	-	-	-	231
♂♂	37	313	53	34	56	42	1	9	14	8	567
♀♀	16	97	27	5	17	1	1	2	3	1	170
Mark.	49	408	79	36	72	43	2	10	17	9	725
W.f.	4	111	1	3	2	1	-	-	-	-	122

Wiederfang-Quote: durchschnittlich; an HO wurde 1988 1 ♂ nach 4 Tagen rückgefangen. Die ♀♀ sind im Gegensatz zur vorhergehenden Art in den Wiederfängen unterrepräsentiert und zeigen eine kürzere Verweildauer.
Distanzen: 2-4
Populationsbiologie: proterandrisch; 1988 wurde an HO nach der Flugzeit der ♀♀ am 18.7. noch ein Trupp von 18 geflogenen ♂♂ gefangen. An diesem Standort fallen besonders starke Nacht-zu-Nacht-Fluktuationen auf, die wohl auf eine erhöhte Dispersionsaktivität hinweisen.
Verbreitungsstrategie: r-Stratege, 2. Gruppe;

Amathes baja (240 Individuen)

Wiederfang-Quote: ein ♂, das an HO 1987 mit einer charakteristischen Flügelverformung auffiel, wurde 3 Tage später wiedergefangen (in der Falle). Die geringfügige Abnormalität hatte auf das Flugverhalten höchstwahrscheinlich keinen Einfluß.

Distanzen: 2-3; die Distanz von ca. 1 km von den Flughafenrändern zum Standort HM (Offenland) wird nur ausnahmsweise bewältigt, wie der starke Häufigkeitsabfall HO/HM zeigt.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Amathes sexstrigata

siehe verringerte Fallendistanzen (8.3.)

1122 Individuen 26,5 % ♀-Rate

603 markiert 18 Wiederfänge

Tab. 71: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Amathes sexstrigata.*

1988	Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH-MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	1	6	139	62	172	136	52	82	5	-	655
Σ zus.	-	10	-	-	-	-	-	-	-	-	10
♂♂	1	10	93	47	94	107	48	60	-	-	460
♀♀	-	4	42	13	64	21	4	18	-	-	166
Mark.	-	14	123	58	151	128	52	77	-	-	603
W.f.	-	6	3	1	5	2	1	-	-	-	18

Wiederfang-Quote: durchschnittlich; die Wiederfänge am Flughafen erfolgten nach 2, 3 und 5 Tagen. Im Garten, einem offensichtlich eher ungeeigneten Lebensraum für diese Art, kam es 1988 zu einem verstärkten Zu- bzw. Durchflug. Dies fand auch seinen Niederschlag darin, daß sich die Rückfänge ausschließlich nach 1-Tages-Intervallen ereigneten. Die Tiere waren also von der direkten Lichtwirkung festgehalten worden. Die ♀♀ sind im Wiederfang deutlich unterrepräsentiert (nur 1 ♀ WaS nach 1 Tag).
Distanzen: 2-3
Populationsbiologie: deutlich proterandrisch! Im Wasserwerk (WaN) stieg in allen 3 Jahren (1987-89) die Populationsdichte zwischen dem 4. und dem 10. August stetig auf einen Maximalwert an, der einen Fang von 30-50 Individuen pro Nacht bewirkte. Relativ pünktlich am 20. August erfolgte dann jeweils ein ziemlich abrupter Zusammenbruch der Population. Die Lebensdauer übersteigt offensichtlich in der Regel einen Wert von 10 Tagen nicht wesentlich.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; diese Art kommt in anderen Gebieten nur sehr kokal und meist nicht häufig vor. Dies erlaubt der Art wohl keine r-Strategie. Bei stärkeren Vermehrungen, wie 1987 und 1988 im Untersuchungsgebiet kann es jedoch zu Abwanderungen auch von fertilen ♀♀ über Strecken von mindestens 1 km kommen.

Amathes xanthographa

siehe verringerte Fallendistanzen (8.3.)

393 Individuen 24,8 % ♀-Rate

315 markiert 8 Wiederfänge

Tab. 72: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Amathes xanthographa.*

1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH-MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	5	3	2	5	7	40	32	18	27	2	141
Σ zus.	-	1	1	1	-	1	-	-	-	-	4
♂♂	-	3	1	1	4	24	23	10	14	1	81
♀♀	5	1	2	4	3	13	6	5	7	1	47
Mark.	5	4	3	5	7	36	29	14	20	2	125
W.f.	-	-	-	1	-	-	1	-	-	-	2

1988	Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH-MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	4	10	31	38	77	18	16	26	5	1	226
Σ zus.	-	22	-	-	-	-	-	-	-	-	22
♂♂	2	22	17	27	40	15	14	22	-	-	159
♀♀	1	4	2	6	15	2	1	1	-	-	32
Mark.	3	26	18	33	55	17	15	23	-	-	190
W.f.	-	4	1	1	-	-	-	-	-	-	6

Wiederfang-Quote: relativ niedrig; die längste nachgewiesene Verweildauer beträgt nur 2 Tage! 1988 erfolgten alle Wiederfänge im Garten nach Intervallen von 1 Tag.
Distanzen: 3-4
Populationsbiologie: deutlich proterandrisch, die ♂♂ schwerpunktmäßig im August, die ♀♀ im September.
Verbreitungsstrategie: r-Stratege, 3. Gruppe; *A. xanthographa* ist im Vergleich mit *A. sexstrigata* die Art mit der größeren Dispersionsaktivität.

Phalaena typica (5 Individuen)
Distanzen: vermutlich 2, bisher keine biotopfremden Tiere festgestellt
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Eurois occulta (4 Individuen)

Distanzen: 2-3
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Anaplectoides prasina (51 Individuen)

Distanzen: 2-3
Larvalökologie: oligophag, bevorzugt findet man die Falter jedoch an Stellen, wo Him- und Brombeeren wachsen. Im reinen Offenland (Flughafen) ist *A. prasina* bestimmt nicht bodenständig. Die beiden HM-Stücke (1986) sind daher vermutlich aus dem Ruderal (ca. 150-300 m Entfernung) zugeflogen.
Die Distanzen von 1 km (Abstand von HM zum nächsten sicheren bodenständigen Vorkommen) bzw. 1,3 km (Wasserwerk→Garten) werden nicht regelmäßig bewältigt. Die 11 WaS-Stücke sind vermutlich zugeflogen (mindestens 50 m).
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Cerastis rubricosa

siehe verringerte Fallendistanzen (8.3.)

171 Individuen 4,8 % ♀-Rate

100 markiert 7 Wiederfänge

Tab. 73: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Cerastis rubricosa.*

1988	Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	-	1	38	24	25	10	1	4	-	-	103
Σ zus.	-	1	-	-	-	-	-	-	-	-	1
♂♂	-	2	34	24	24	10	1	4	-	-	99
♀♀	-	-	4	-	1	-	-	-	-	-	5
Mark.	-	2	37	22	24	10	1	4	-	-	100
W.f.	-	-	2	4	1	-	-	-	-	-	7

Wiederfang-Quote: hoch, bei langen Verweildauern, die jedoch - zumindest teilweise - durch kühlere Witterung bedingt sein dürften. Vielleicht suchen die Imagines ähnlich wie die Arten der Gattung *Orthosia* nach dem Schlüpfen Nektarquellen und werden an Standorten mit blühenden Weiden "seßhaft". Ein "Einflug" in den Siedlungsbereich und in das Gebiet des Dachauer Mooses kommt jedoch in nur geringem Maß vor, wodurch im Gegensatz zu den Orthosien ein deutliches Häufigkeitsgefälle entsteht.
Distanzen: 2 (-3?)
Larvalökologie: polyphag an niedrigen Pflanzen
Populationsbiologie: in allen Jahren tauchten bisher im Juni frische Exemplare auf, es handelt sich jedoch wohl nicht um eine zweite Generation.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Cerastis leucographa (23 Individuen)

Distanzen: 2; die Distanz von ca. 1 km ins Offenland hinein (HM, auch HW) wird anscheinend nur selten bewältigt, an den genannten Stellen keine Nachweise
Verbreitungsstrategie: K-Stratege, 6. Gruppe; die gesammelten Daten deuten auf ein ähnliches Verhalten wie bei *C. rubricosa* hin, *C. leucographa* scheint lediglich etwas stärker habitatgebunden zu sein.

Mesogona oxalina (15 Individuen)

Distanzen: 2
Larvalökologie: die Raupe lebt oligophag an verschiedenen Laubgehölzen, v.a. Weiden und Pappeln; die HM-Stücke stammen daher sehr wahrscheinlich aus dem 150-300 m entfernten Ruderal. Diese Distanz wird mit erstaunlicher Konstanz bewältigt, 1 km jedoch so gut wie nie: We→Mo, HM→HO und HM→HW; an den letztgenannten Standorten konnte die Art nicht nachgewiesen werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

HADENINAE

Discestra trifolii (28 Individuen)

Distanzen: 4
Verbreitungsstrategie: r-Stratege, 1. Gruppe; in dieses Bild passen auch die Häufigkeitsschwankungen von Jahr zu Jahr, das den anderen Wanderfaltern entsprechende Häufigkeitsmuster innerhalb des Fangstellen-Netzes sowie das gleichzeitige Auftreten mit diesen anderen Arten in besonderen "Wanderfalternächten".

Polia bombycina

70 Individuen 19,0 % ♀-Rate

62 markiert 2 Wiederfänge

Wiederfang-Quote: relativ hoch; es handelt sich um zwei ♂♂, einen Ortswiederfang an WNo nach 3 Tagen und einen Ortswechsler von WaN→WNo (50 m) nach 2 Tagen.
Distanzen: 2-3
Larvalökologie: die HM-Stücke könnten zu einem Verbreitungszentrum im Ruderal mit Weide als bevorzugter Futterpflanze gehören, eine eindeutige Aussage ist wegen der Oligophagie dieser Art nicht möglich.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Polia nebulosa (38 Individuen)

Distanzen: 2-3
Larvalökologie: etwas mehr an bebuschtes Gelände gebunden als vorige Art, biotopfremde Tiere wurden bisher nicht beobachtet.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Pachetra sagittigera

114 Individuen 9,9 % ♀-Rate

110 markiert 2 Wiederfänge

Tab. 74: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Pachetra sagittigera*.

1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH-MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	-	-	-	-	-	-	5	35	42	-	82
♂♂	-	-	-	-	-	-	4	32	36	-	72
♀♀	-	-	-	-	-	-	1	2	4	-	7
Mark.	-	-	-	-	-	-	5	34	40	-	79
W.f.	-	-	-	-	-	-	-	-	2	-	2

1988	WALD Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH-MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	-	-	-	-	-	3	14	15	-	-	32
♂♂	-	-	-	-	-	3	13	12	-	-	28
♀♀	-	-	-	-	-	-	1	3	-	-	4
Mark.	-	-	-	-	-	2	14	15	-	-	31
W.f.	-	-	-	-	-	-	-	-	-	-	-

Wiederfang-Quote: durchschnittlich, es handelt sich um zwei Ortswiederfänge (♂♂) an HW nach jeweils 2 Tagen.
Distanzen: im Habitat 3, außerhalb 2
Larvalökologie: polyphag an niedrigen Pflanzen und Gräsern! Dennoch ist eine starke Habitatbindung (Halbtrockenrasen) im Untersuchungsgebiet festzustellen: Außerhalb der drei Flughafen-Standorte wurde diese Art bisher nur 1989 an WaN (2 ♂♂) beobachtet. Schon in einer 30 m tiefen Einbuchtung in den Wald (HO) ist - jahrweise konstant - ein starker Häufigkeitsabfall festzustellen. Im Flughafengebiet ist *P. sagittigera* wohl allgemein verbreitet, in 300-400 m Entfernung (SiS) war 1987 kein Stück nachzuweisen.
Populationsbiologie: proterandrisch
Verbreitungsstrategie: K-Stratege, 5. Gruppe

Sideridis albicolon (6 Individuen)

Distanzen: im Habitat 2-3, außerhalb 1-2
Larvalökologie: Auch hier wäre durch die (angebliche) Polyphagie der Raupen die Lebensgrundlage in einem weitaus größeren Areal gegeben als tatsächlich besetzt wird. *S. albicolon* ist streng habitatgebunden (Steppenheidecharakter) und war schon an HO nicht mehr nachzuweisen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Heliophobus reticulata (16 Individuen)

Distanzen: 2
Larvalökologie: oligophag an einigen Carophyllaceen, wie die beiden vorigen Arten strenger habitatgebunden, als dies von den weiter verbreiteten Raupenfutterpflanzen her "nötig wäre".
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Mamestra brassicae (63 Individuen)

Distanzen: 3-4
Populationsbiologie: bivoltin
Verbreitungsstrategie: r-Stratege, 1. Gruppe

Mamestra persicariae (146 Individuen)

Distanzen: 3-4; die deutliche Häufigkeitsdifferenz zwischen WaN und WNw (nur 100 m voneinander entfernt) weist dennoch auf Barrieren gegen die Verbreitung hin: In Wäldern ist *M. persicariae* seltener anzutreffen.
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Mamestra contigua (20 Individuen)

Distanzen: 3
Larvalökologie: *M. contigua*-Raupen sind relativ polyphag; vermutlich bilden jedoch für die an HM nachgewiesenen Stücke die Weiden des Ruderals (150-300 m entfernt) die Lebensgrundlage. 1988 befand sich darunter auch ein fertiles ♀. Interessanterweise konnte in 1 km Entfernung (HO) über 3 Jahre hinweg kein Exemplar festgestellt werden.
Populationsbiologie: bivoltin
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Mamestra w-latinum

43 Individuen 24,4 % ♀-Rate

41 markiert 2 Wiederfänge

Wiederfang-Quote: durchschnittlich: ein ♀ wurde an WaS 1988 am nächsten Tag wiedergefangen, war also nur vom Licht festgehalten worden, dazu kommt ein "echter" Wiederfang 1987 HW nach 2 Tagen (♂).
Distanzen: 3; unter den im Untersuchungsgebiet festgestellten Mamestren wohl die Art mit der größten Habitattreue (trockene Wiesen). Die im Garten vereinzelt zu beobachtenden Stücke sind vielleicht zugeflogen, auch die (Trittstein-)Besiedlung des Wasserwerks läßt vermuten, daß *M. w-latinum*-♀♀ bisweilen Distanzen von 1 km zurücklegen.
Populationsbiologie: bivoltin, proterandrisch
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Mamestra thalassina (77 Individuen)

Distanzen: 2-3
Larvalökologie: *M. thalassina* ist zwar eine polyphage Art, bevorzugte Futterpflanzen sind jedoch Laubgehölze und -gebüsche; im reinen Offenland ist diese Art wohl nicht bodenständig. Das HM-Stück (♂) ist vielleicht vom Ruderal her zugeflogen (200-300 m).
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Mamestra suasa

371 Individuen 32,2 % ♀-Rate

93 markiert 3 Wiederfänge

Wiederfang-Quote: sehr niedrig! Alle drei Wiederfänge (♂♂♀) erfolgten an WaS 1988 nach 1 Tag und stellen somit keinen Hinweis auf ein natürliches Verbleiben in der Umgebung dar. Hier waren 31 Individuen markiert worden.
Distanzen: 4
Populationsbiologie: bivoltin; in der Siedlung wurde die erste Generation von *M. suasa* nur sehr vereinzelt beobachtet, es gilt analog das bei *Amathes c-nigrum* Gesagte, vor allem für den Fangplatz SiM. Die Weibchen-Rate der 2. Generation liegt höher als die der ersten.
Auffällig ist die besondere Korrelation der Anflugaktivität mit den sogenannten Wanderfalternächten. Dies ist ein weiterer Hinweis darauf, daß auch einige andere hochmobile Arten "mitfliegen".
Verbreitungsstrategie: r-Stratege, 2. Gruppe

Mamestra oleracea (88 Individuen)

Distanzen: 3 (-4?)
Larvalökologie: Wenn die Angabe in KOCH (1984) stimmt, daß die Raupen (nur) Garten und Feldgewächse fressen, müßte das HM-Exemplar (♂) 1986 zumindest vom Gut Hochmutting her zugeflogen sein (ca. 500-600 m). Interessant ist auch der starke Häufigkeitsunterschied WaN-WNw, der für Barrieren gegen die freie Beweglichkeit dieser Art spricht.
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Mamestra pisi (4 Individuen)

Distanzen: 3 (-4?)
Larvalökologie: die HM-♂♂ 1988 entwickelten sich vermutlich 150-300 m entfernt an den Weiden des Ruderals zum Falter.
Verbreitungsstrategie: r-Stratege, 5. Gruppe

Hadena rivularis (10 Individuen)

Distanzen: 3
Larvalökologie: die Raupe lebt an verschiedenen Nelkengewächsen, die in der Nähe aller Fundorte vorkamen.
Populationsbiologie: bivoltin
Verbreitungsstrategie: r-Stratege, 3. Gruppe; ähnlich wie wohl bei allen Vertretern dieser Gruppe der "Nelkeneulen" wird auch hier ein vorprogrammiertes Umherstreifen der ♀♀ zur Aufsuche der nicht immer standorttreuen Futterpflanzen nötig sein.

Hadena lepida (10 Individuen)

Distanzen: 3
Larvalökologie: wie vorige Art; bei dem frischen ♂, das 1986 im Garten gefangen wurde, könnte es sich um einen Nachkommen eines für die Dauer eines Jahres geglückten Kolonisationsversuches handeln: Seit 1985/1986 wächst im Garten ein sich von Jahr zu Jahr ausbreitender Bestand von Roten Lichtnelken (*Silene dioica*).
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Hadena compta (5 Individuen)

Distanzen: 2-3
Larvalökologie: die Grundlage für die Konstanz des Auftretens im Garten in den letzten Jahren liegt wohl in den Beständen der Roten Lichtnelke.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; nach LATTIN (1967) unternahm *H. compta* in diesem Jahrhundert Arealausweitungen.

Hadena confusa

Distanzen: vermutlich 2-3
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Hadena bicruris (5 Individuen)

Distanzen: 2-3
Larvalökologie: im Garten ist gleichzeitig mit dem Erscheinen der Bestände der Roten Lichtnelke seit 1986 auch regelmäßig *H. bicruris* nachgewiesen worden. Die Kolonisation erfolgte erstaunlich rasch, wenn man bedenkt, daß vorher nie ein (zugeflogenes) Exemplar festgestellt wurde.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Lasionycta nana (1 Individuum)

Distanzen: vermutlich 2-3
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Eriopygodes imbecilla (1 Individuum)

Distanzen: 1-2
Larvalökologie: Die Raupe lebt an "niedrigen Pflanzen und Gräsern". Trotz dieser breitgefächerten Lebensgrundlage handelt es sich in Südbayern um ein sehr lokal vorkommendes Glazialrelikt.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; ein neu geschaffenes (hypothetisches) Feuchtgebiet im Siedlungsbereich (3,8 km entfernt) wäre in der Zeit der bisherigen Lichtfallenerhebungen im Garten (ca. 10 Jahre) höchstwahrscheinlich noch nicht besiedelt worden, auch wenn es noch so naturnah gestaltet worden wäre.

Cerapteryx graminis (1 Individuum)

Distanzen: vermutlich 2-3
Larvalökologie: an Graswurzeln, gern an Sauergräsern, die Futterquelle wäre also reichlich vorhanden; dennoch ist diese Art in der unteren Hochebene Südbayerns eine recht lokale Erscheinung.
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Tholera cespitis (1 Individuum)

Distanzen: vermutlich 2-3
Larvalökologie: an Gräsern, vorwiegend an den Wurzeln; dadurch spielen Flächen wie das Flughafengebiet, das extensiv bewirtschaftet wird (Schafweide), eine bedeutende Rolle für diese Art, die wohl durch den Verbiß nicht besonders gestört wird.
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Tholera decimalis

282 Individuen 6,3 % ♀-Rate

183 markiert 4 Wiederfänge

Tab. 75: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Tholera decimalis*, 1988 wurden nur wenige Stücke markiert.

1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH-MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	-	-	3	2	2	6	53	66	40	1	173
Σ zus.	-	-	-	1	-	-	-	-	-	-	1
♂♂	-	-	3	3	2	5	51	63	36	1	164
♀♀	-	-	-	-	-	1	2	3	4	-	10
Mark.	-	-	2	3	2	6	53	66	40	1	173
W.f.	-	-	-	-	-	1	1	2	-	-	4

Wiederfang-Quote: durchschnittlich; es handelt sich um 4 ♂♂, das WaN-Stück wurde nach 4 Tagen, die drei Flughafen-Exemplare nach je 2 Tagen wiedergefangen. Die mittlere Verweilzeit errechnet sich also zu relativ niedrigen 2,5 Tagen. Für eine Offenlandart liegen diese Wiederfang-Daten jedoch vergleichsweise hoch.

Distanzen: ♂♂ 3-4, ♀♀ 2-3

Larvalökologie: siehe Bemerkungen zu voriger Art; auch die Raupen dieser Art bevorzugen eher trockene Wiesen, sie wurde beispielsweise 700 m vom Garten entfernt in einer Wegwarten-Gesellschaft (*Cichorietum intybi*) gefunden. Unter Umständen ist T. decimalis im eigentlichen Ortsbereich nicht bodenständig.

Populationsbiologie: die schwerfällig wirkenden und fliegenden ♀♀ sind vermutlich ortstreuer als die ♂♂; dieses verminderte Flugvermögen kann auch für die geringe ♀-Rate in der Lichtfalle verantwortlich sein.
Die Tatsache, daß im Ort noch nie ein ♀♀ gefunden wurde, mag als weiterer Hinweis darauf gewertet werden, daß es sich bei den Siedlungs-Stücken nur um zufliegende ♂♂ handelt.

Verbreitungsstrategie: intermediärer Typ (nach SPITZER et al., 1984 nahe einer K-Strategie), 3. Gruppe; die starke Vermehrung 1986 im Flughafengebiet (eine Fangnacht mit über 100 Exemplaren an HM) war von einem ebenfalls starken Flug im Garten begleitet, was wohl zumindest teilweise auf abwandernde Individuen zurückzuführen ist.

Panolis flammea

85 Individuen 16,7 % ♀-Rate

83 markiert — kein Wiederfang

Wiederfang-Quote: sehr niedrig

Distanzen: 4

Larvalökologie: an Nadelhölzer gebunden (v.a. Kiefer), die HM-Stücke sind daher mit Sicherheit mindestens 1 km von den Flughafenrändern her zugeflogen. Diese Distanz scheint für *P. flammea* keinerlei Verbreitungshemmnis darzustellen, sie wird zwar nicht regelmäßig, bisweilen jedoch in größeren Anzahlen und auch von fertilen ♀♀ (1987 1 ♀, 1986 war keine Geschlechtsbestimmung durchgeführt worden) geflogen! Die festgestellte Expansion 1986 fällt mit einer besonders guten Bestandsentwicklung vieler Kiefernarten in diesem Jahr zusammen.
Auch bei kleineren Fallendistanzen (Wasserwerk) sind im 100 m-Bereich keine Häufigkeitsgradienten festzustellen.

Verbreitungsstrategie: r-Stratege, 3. Gruppe; im Gegensatz dazu steht die Beobachtung SCHWERDTFEGERS (1978) einer relativ langsamen Wiederbesiedlung eines künstlich "entleerten" Waldabschnitts.

Orthosia cruda

175 Individuen 33,1 % ♀-Rate

173 markiert 2 Wiederfänge

Tab. 76: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Orthosia cruda*.

1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH-MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	-	8	14	5	-	4	29	9	9	-	78
Σ zus.	-	-	-	4	-	1	-	-	-	-	5
♂♂	-	4	12	6	-	3	18	3	7	-	53
♀♀	-	4	2	3	-	2	11	6	2	-	30
Mark.	-	8	14	9	-	5	29	9	9	-	83
W.f.	-	-	-	-	-	1	-	-	-	-	1

1988	Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH-MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	10	1	5	6	3	57	-	2	2	6	92
♂♂	6	1	2	4	2	39	-	2	2	6	64
♀♀	4	-	3	2	1	18	-	-	-	-	28
Mark.	10	1	5	5	3	56	-	2	2	6	90
W.f.	-	-	-	1	-	-	-	-	-	-	1

Wiederfang-Quote: niedrig! Nur im Wasserwerk etwas höher, 1987 wurde ein ♀ nach 2 Tagen, 1988 ebenfalls ein ♀ nach 9 (!) Tagen wiedergefangen. Die lange Verweildauer sowie die deutliche Überrepräsentierung im Wiederfangergebnis lassen erkennen, daß die ♀♀ im Vergleich zu den ♂♂ etwas ortstreuer sind.
Distanzen: ♀♀ 2 (-3?), ♂♂ 3-4
Larvalökologie: an verschiedenen Laubbäumen, die nach HM zugeflogenen Stücke (auch fertile ♀♀!) stammen mindestens aus dem 150-300 m entfernten Ruderal, teilweise wohl auch von den Flughafenrändern (> 1 km).
Populationsbiologie: proterandrisch
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Orthosia populi

37 Individuen 14,3 % ♀-Rate

34 markiert kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein; im Moos wurden am Standort We 1988 31 Individuen markiert, die fehlenden Rückfänge erklären sich durch den im Frühling an diesem Ort nur wöchentlich betriebenen Lichtfang. Hier könnte die Art dennoch relativ ortsfest sein.
Distanzen: 2-3
Larvalökologie: an Espe und Schwarzpappel, die nächstgelegenen Futterpflanzen liegen von HM ca. 1 km, vom Garten ca. 500 m entfernt. Diese Distanzen liegen nicht im normalen Bereich der Dispersionsaktivität von *O. populi* (siehe Häufigkeitsdifferenz zu "We"), werden jedoch ohne größere Probleme bewältigt. Im Ort 1988 auch ein fertiles ♀! Die Distanz von 2 km (We→Au), ausgehend vom Verbreitungszentrum konnte 1988 offensichtlich nicht zurückgelegt werden.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Orthosia gracilis

31 Individuen 60,0 % ♀-Rate

30 markiert kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein.
Distanzen: 2-3
Larvalökologie: Durch die Raupenfutterpflanzen eher an feuchte Standorte gebunden, nimmt jedoch auch Schafgarbe (*Achillea millefolium*) und Beifuß (*Artemisia* spec.).
Verbreitungsstrategie: intermediärer Typ, 4. Gruppe

Orthosia stabilis

192 Individuen 30,5 % ♀-Rate

187 markiert 4 Wiederfänge

Tab. 77: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Orthosia stabilis*.

1987	SIEDLUNG		Garten		WALD		HALBTROKKENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	3	7	32	10	1	13	9	6	–	3	84
Σ zus.	–	–	1	2	–	3	1	–	–	–	7
♂♂	1	4	20	6	–	13	5	5	–	–	54
♀♀	2	3	11	6	1	3	5	1	–	3	35
Mark.	3	7	31	12	1	16	10	6	–	3	89
W.f.	–	–	–	1	–	–	–	–	–	–	1

1988	WALD Garten		WALD Wasserwerk			HALBTROKKENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	15	12	21	6	8	28	1	5	1	4	101
♂♂	10	12	16	5	7	21	1	2	1	3	78
♀♀	5	–	5	1	1	7	–	3	–	1	23
Mark.	14	12	21	6	7	27	1	5	1	4	98
W.f.	1	1	1	–	–	–	–	–	–	–	3

Wiederfang-Quote: durchschnittlich, die mittlere Verweildauer betrug 3,0 Tage; aus dem Rahmen fällt das ♀ im Wasserwerk mit einem Rückfang-Intervall von 5 Tagen.
Die ♀♀ sind im Wiederfangergebnis mit 50 % vertreten.
Distanzen: 3-4; die Häufigkeitsdifferenz WaN/WNw spricht dennoch für Hemmnisse in der Beweglichkeit dieser Art.
Larvalökologie: unter den von KOCH (1984) aufgezählten Futterpflanzen befindet sich keine, die am HM-Ruderal vorkäme. Die mit hoher Konstanz zufliegenden Stücke (auch ♀♀) hatten also mindestens 800-1000 m vom Flughafenrand her zurückgelegt. Das Ruderal wird offensichtlich nur zur Nektaraufnahme der Imagines aufgesucht.
Populationsbiologie: proterandrisch
Verbreitungsstrategie: r-Stratege, 2. Gruppe

Orthosia incerta

269 Individuen 25,1 % ♀-Rate

265 markiert 8 Wiederfänge

Tab. 78: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Orthosia incerta.*

1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH-MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	4	29	48	8	5	22	15	8	10	4	153
Σ zus.	-	-	-	7	-	2	-	-	-	-	9
♂♂	4	20	41	12	2	17	11	5	7	3	122
♀♀	-	9	7	2	3	7	4	3	3	1	39
Mark.	4	29	48	14	5	24	15	8	10	4	161
W.f.	-	-	2	-	1	1	-	-	-	-	4

1988	Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH-MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	5	5	27	10	22	16	1	5	1	15	107
♂♂	4	5	21	6	14	13	1	3	1	10	78
♀♀	1	-	6	4	8	3	-	2	-	4	28
Mark.	5	5	27	10	21	16	1	5	1	13	104
W.f.	-	-	3	-	1	-	-	-	-	-	4

Wiederfang-Quote: relativ hoch (vor allem im Wasserwerk), bei einer recht langen mittleren Verweildauer von 4,25 Tagen! ♀♀-Rate im Wiederfangergebnis 2/8 = 25 %. Beide ♀-Rückfänge erfolgten schon nach einem 2-Tage-Intervall.
Im Wasserwerk 1988 (verringerte Fallendistanzen) betrug die Wiederfang-Quote sogar 7 % bei einer mittleren Verweildauer von 4 Tagen.
Gemessen am Wiederfangergebnis handelt es sich hier um die ortstreueste der im Gebiet beobachteten Orthosien.
Distanzen: 2-3; der deutliche Häufigkeitsgradient WNw→WaN spricht auch für Barrieren gegen die freie Beweglichkeit dieser Art.
Larvalökologie: im Vergleich zu den anderen Orthosien relativ polyphag, die HM-Stücke stammen aber wohl zumindest aus dem Ruderal (200-300 m). Diese Distanz scheint auch von ♀♀ ohne Probleme bewältigt zu werden.
Populationsbiologie: proterandrisch
Verbreitungsstrategie: intermediärer Typ, 4. Gruppe

Orthosia munda

26 Individuen 23,1 % ♀-Rate

26 markiert kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein
Distanzen: 2-3
Larvalökologie: das 1987 an HM festgestellte ♂ stammte mindestens aus dem Ruderal (150-300 m entfernt).
Populationsbiologie: proterandrisch
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Orthosia gothica

siehe verringerte Fallendistanzen (8.3.)

835 Individuen 32,3 % ♀-Rate

814 markiert 15 Wiederfänge

Tab. 79: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Orhosia gothica.*

1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH-MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	30	25	118	37	10	121	37	11	19	13	421
Σ zus.	-	-	-	19	3	10	-	-	-	-	32
♂♂	15	18	82	45	8	80	28	7	12	9	304
♀♀	15	7	35	8	5	51	9	4	5	4	143
Mark.	30	25	116	52	13	131	37	11	17	13	445
W.f.	-	-	-	-	-	4	-	-	-	-	4

1988	Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH-MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	39	37	86	60	71	37	7	15	8	21	381
Σ zus.	-	1	-	-	-	-	-	-	-	-	1
♂♂	22	30	56	36	47	29	5	11	5	15	256
♀♀	17	6	30	23	24	8	2	4	3	6	123
Mark.	39	35	81	58	69	36	7	15	8	21	369
W.f.	-	1	8	-	2	-	-	-	-	-	11

Wiederfang-Quote: standortabhängig: Im Wasserwerk hoch, sonst recht niedrig. Die ♀♀ sind im Wiederfangergebnis mit 2/15=13,3 % etwas unterrepräsentiert; deren Verweildauern liegen mit jeweils 2 Tagen auch unter denen der ♂♂ (durchschnittlich 5,5 Tage).

Im Garten wurde 1988 ein ♂, das an SiN markiert wurde nach 4 Tagen 30 m entfernt an WaS wiedergefunden. In diesem Intervall lagen 3 gute Flugnächte für *O. gothica*. Bisweilen scheint jedoch kühle Witterung für ein verlängertes Verbleiben im Gebiet verantwortlich zu sein.

Distanzen: 3; für die ♀♀ ist vielleicht eine höhere Dispersionsaktivität zu veranschlagen.

Larvalökologie: unter den Arten der Gattung *Orthosia* vergleichsweise polyphag; jedoch an HM wohl nicht bodenständig, die ♀♀-Rate liegt hier im gleichen Bereich wie im Gesamtergebnis.

Populationsbiologie: deutlich proterandrisch

Verbreitungsstrategie: intermediärer Typ, 2. Gruppe; wie auch bei einigen anderen Orthosien scheint an Standorten mit großem Nektarangebot für die Imagines (blühende Weiden) die Ortstreue erhöht zu sein. An den anderen Stellen (z.B. im Garten) werden verstärkt solche Individuen erfaßt, die sich auf "Suchflügen" befinden.
Die Dispersionsaktivitäten der ♀♀ liegen offensichtlich auf etwas höherem Niveau als bei den ♂♂. Da es für die ♀♀ wohl keine Schwierigkeiten bereitet, die mehr oder weniger ubiquitär verbreiteten Raupenfutterpflanzen zur Eiablage zu suchen, scheint es sich um Suchflüge nach Nektarquellen zu handeln, um eine optimale Nährstoffversorgung für das Eiablagegeschehen zu gewährleisten; in den noch etwas kühlen Nächten der Flugzeit dieser Art dürfte überdies auch der Wärmeverlust eine bedeutendere Rolle spielen als bei anderen Arten.

Mythimna turca (133 Individuen)

Distanzen: 2; das HM-Stück (♂) stammt vielleicht aus dem Ruderal (150-300 m entfernt), sonst konnten bisher keine biotopfremden Tiere festgestellt werden. Der Häufigkeitsgradient SiN→WaS (30 m) könnte ebenfalls für eine geringe Dispersionsaktivität der an WaS gefangenen Tiere sprechen.

Verbreitungsstrategie: K-Stratege, 6. Gruppe

Mythimna conigera (71 Individuen)

Distanzen: 3

Larvalökologie: die Raupe lebt an "Gräsern und niedrigen Pflanzen", die Art ist im Gebiet an trockenere Wiesen gebunden. Die 3 im Garten festgestellten Tiere (das Stück 1987 war ein ♂) sind wahrscheinlich von den Verbreitungszentren (Flughafen, Wasserwerk) zugeflogen, haben demnach 1-1,3 km zurückgelegt. Betrachtet man auch das stark polarisierte Häufigkeitsverhältnis WaN/WNw, so scheinen Distanzen von ca. 1 km schon eher an der Obergrenze der normalen Dispersionsaktivität zu liegen.

Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Mythimna ferrago (63 Individuen)

Distanzen: 3 (-4?)

Verbreitungsstrategie: r-Stratege, 3. Gruppe

Mythimna albipuncta (23 Individuen)

Distanzen: 4

Verbreitungsstrategie: r-Stratege, 1. Gruppe; auch das Haufigkeitsmuster innerhalb des betriebenen Fallennetzes entspricht dem der anderen typischen Wanderfalterarten.

Mythimna vitellina (1 Individuum)

Distanzen: 4

Verbreitungsstrategie: r-Stratege, 1. Gruppe

Mythimna pudorina (5 Individuen)

Distanzen: 2-3

Larvalökologie: die Raupe ist an "Schilf und nach der Überwinterung an Moorgräser" gebunden. An HM wurden 2 höchstwahrscheinlich aus dem Ruderal (150-300 m entfernt) stammende ♂♂ gefangen. Das HO-♂ flog zumindest vom mit Schilf bestandenen Schloßkanal her zu (200 m), die Lebensgrundlage der Garten-Exemplare (♂♀) liegt unter Umständen in der Begleitvegetation von Gartenteichen (mindestens 200 m), das WNo-Stück (♀) schließlich entwickelte sich direkt am Fangplatz an einem 1 m^2 großen Schilfhorst (!), wenn es nicht vom nächsten Standort der Futterpflanze (ca. 1 km) her zuflog. Der Schilfbestand befand sich erst seit 2 Jahren an dieser Stelle, eine Kolonisation über (mindestens) 1 km kann also im Einzelfall recht schnell erfolgen.

Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Mythimna impura

siehe verringerte Fallendistanzen (8.3.)

439 Individuen   20,6 % ♀-Rate

424 Markiert   25 Wiederfänge

Tab. 80: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Mythimna impura.*

1987	SIEDLUNG		WALD Garten		WALD		HALBTROK-KENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	5	2	6	7	12	70	21	6	5	2	136
Σ zus.	-	-	-	1	-	9	5	3	3	-	21
♂♂	5	2	5	5	9	52	20	5	8	1	112
♀♀	-	-	1	3	3	21	5	4	-	1	38
Mark.	5	2	6	8	12	73	25	9	6	1	147
W.f.	-	-	-	-	-	4	2	-	-	-	6

1988	Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	4	11	78	37	94	19	9	11	5	3	265
Σ zus.	-	17	-	-	-	-	-	-	-	-	17
♂♂	3	21	59	31	79	18	9	8	3	3	228
♀♀	1	7	19	6	13	1	-	2	1	-	50
Mark.	4	28	75	35	90	19	9	10	4	3	277
W.f.	-	4	6	2	7	-	-	-	-	-	19

Wiederfang-Quote: sehr hoch bei langen Verweildauern, ein HO-Ex. (1987) sogar erst nach 27 Tagen. Im Garten nur kurze Verweilzeiten (1-2 Tage), hier und vielleicht auch am Flughafen (außerhalb des Habitats) etwas mobiler. Die ♀♀ sind mit 1/25 = 4 % im Wiederfangergebnis deutlich unterrepräsentiert, der einzige ♀-Wiederfang erfolgte auch WaS 1988 nach 1 Tag, also irregulär.
Distanzen: im Habitat 2, außerhalb 2-3; ♀♀ vielleicht 3
Larvalökologie: Raupenfutterpflanze vermutlich nicht "Gräser" (KOCH, 1984) allgemein, sondern mit starker Vorliebe feuchtigkeitsliebende Pflanzen wie *Carex* spec. oder *Phragmites*. Die HM-Ex. wären dann vom Ruderal her (150-300 m) zugeflogen, die HW-Stücke vom Würmkanal (ca. 100 m).
Populationsbiologie: deutlich proterandrisch.
Verbreitungsstrategie: K-Stratege, 4. Gruppe (vgl. folgende Art), dies stellt wohl eine Anpassung an die Bedürfnisse hinsichtlich der Futterpflanzen dar, welche ja nicht gleichmäßig über das Gebiet verbreitet sind, an Gewässern oder anderen feuchten Stellen jedoch über Jahre hinweg stabile Bestände bilden können. Eine Emigration aus solchen Stellen stellt dann stets eine Gefahr dar, nicht mehr zur Fortpflanzung zu gelangen, bzw. die zur Eiablage optimalen Pflanzen nicht mehr zu finden.

Mythimna pallens

148 Individuen   31,2 % ♀-Rate

139 Markiert   1 Wiederfang

Tab. 81: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Mythimna pallens.*

1987	SIEDLUNG		WALD Garten		WALD		HALBTROK-KENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	1	3	2	1	1	8	3	5	7	2	33
Σ zus.	1	1	-	-	-	4	-	1	2	-	9
♂♂	1	1	2	1	1	9	3	6	7	1	32
♀♀	-	3	-	-	-	3	-	-	2	1	9
Mark.	1	4	2	1	1	12	3	6	9	2	41
W.f.	-	-	-	-	-	-	-	-	-	-	-

1988	Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	3	2	12	11	23	10	8	29	-	4	102
Σ zus.	-	4	-	-	-	-	-	-	-	-	4
♂♂	3	5	8	8	11	7	5	17	-	1	65
♀♀	-	1	3	3	9	3	3	12	-	-	34
Mark.	3	6	11	11	20	10	8	28	-	1	98
W.f.	-	1	-	-	-	-	-	-	-	-	1

Wiederfang-Quote: sehr niedrig! Der Wiederfang WaS (♂) fand nach 1 Tag statt, das Tier war also von der direkten Lichtwirkung gefangengehalten worden.
Distanzen: 3-4
Larvalökologie: im Gegensatz zur vorhergehenden Art werden Pflanzen der Familie *Poaceae* bevorzugt.
Populationsbiologie: bivoltine Art (*M. impura* scheint dagegen im Gebiet nur univoltin zu sein).
Verbreitungsstrategie: r-Stratege, 2. Gruppe; völlig anders als bei der habituell eigentlich sehr ähnlichen *M. impura* zeigt die Verbreitung von *M. pallens* im Gebiet ein den Wanderfaltern ähnliches Muster. Die Verbreitungsstrategie ist korreliert mit der ubiquitären Verbreitung der Raupenfutterpflanzen: Die Art kann es sich "leisten", den Ort zu wechseln.

Mythimna l-album

Distanzen: 4
Verbreitungsstrategie: r-Stratege, 1. Gruppe

Leucania comma

97 Individuen 4,2 % ♀-Rate

95 Markiert 3 Wiederfänge

Tab. 82: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Leucania comma.*

1987	SIEDLUNG		Garten		WALD		HALBTROKKENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	-	-	-	-	-	-	1	23	12	-	36
Σ zus.	-	-	-	-	-	-	-	-	2	-	2
♂♂	-	-	-	-	-	-	1	19	14	-	34
♀♀	-	-	-	-	-	-	-	3	-	-	3
Mark.	-	-	-	-	-	-	1	22	14	-	37
W.f.	-	-	-	-	-	-	-	-	-	-	-

1988	Garten		WALD Wasserwerk			HALBTROKKENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	-	-	-	-	1	1	41	16	-	-	59
♂♂	-	-	-	-	1	1	39	16	-	-	57
♀♀	-	-	-	-	-	-	1	-	-	-	1
Mark.	-	-	-	-	1	1	40	16	-	-	58
W.f.	-	-	-	-	-	-	2	1	-	-	3

Wiederfang-Quote: relativ hoch, allerdings bei einer kurzen mittleren Verweildauer von 2 Tagen; es handelt sich um 3 ♂♂.
Distanzen: 2; als Ausnahme kann auch einmal ein Kilometer bewältigt werden, wie das zugeflogene ♂ im Garten 1983 sowie die ♂♂ im Wasserwerk zeigen. Die letztgenannten Exemplare sind entweder über die Trittsteine im 100-300 m-Abstand zugeflogen oder weisen auf eine sehr kleine Polulation hin, die eine solche Trittsteinbesiedlung ausgehend von den im Osten liegenden Halbtrockenrasengebieten geschafft hat.
Schon in der 30 m-Ausbuchtung des Habitats an HO zeigt sich ein drastischer Häufigkeitsabfall, was für niedrige Dispersionsaktivitäten spricht.
Populationsbiologie: die Tatsache, daß an HW kein ♀ festgestellt wurde, könnte dahingehend interpretiert werden, daß bei einer höheren Dispersionsaktivität der ♂♂ sogar hier schon, am Rand des Halbtrockenrasengebietes ein höherer Prozentsatz von "eingewanderten Tieren" vorliegt.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

AMPHIPYRINAE

Amphipyra pyramidea

110 Individuen 37,5 % ♀-Rate

79 Markiert kein Wiederfang

Wiederfang-Quote: niedrig, auch bei täglichem Fang WaS 1988 von 13 markierten Exemplaren keines wiedergefangen
Distanzen: 4, über biotopfremdes Gebiet nur 2; denkbar wäre auch, daß über biotopfremdem Gebiet zwar Dispersion (Migration) stattfindet, das Licht jedoch nicht angeflogen wird.
Larvalökologie: die Raupe lebt an verschiedenen Laubgehölzen.
Populationsbiologie: proterandrisch
Verbreitungsstrategie: r-Stratege, 3. Gruppe; die Art wird bisweilen als wanderverdächtig aufgeführt. Im Untersuchungsgebiet entsprach das Häufigkeitsmuster im Lichtfallennetz weitgehend dem der typischen Wanderfalterarten. Das Auftreten war, vor allem an HW, oft mit den Wanderfalternächten korreliert.

Amphipyra berbera

Distanzen: 4, vermutlich wie *A. pyramidea*
Larvalökologie: siehe Bemerkungen zur vorigen Art
Verbreitungsstrategie: r-Stratege, 5. Gruppe; Verhältnisse vermutlich wie bei *A. pyramidea*

Amphipyra tragopoginis

190 Individuen 20,0 % ♀-Rate

139 Markiert 5 Wiederfänge

Tab. 83: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Amphipyra tragopoginis.*

1987	SIEDLUNG		Garten		WALD		HALBTROKKENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	4	8	1	7	2	9	5	8	71	-	115
Σ zus.	-	2	3	3	-	-	-	-	-	-	8
♂♂	4	7	3	6	-	4	4	3	41	-	72
♀♀	-	-	1	4	-	2	1	3	11	-	22
Mark.	4	7	4	10	-	6	5	6	52	-	94
W.f.	-	-	-	-	-	-	-	-	-	-	-

1988	Garten		WALD Wasserwerk			HALBTROKKENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	1	8	10	3	3	8	4	22	1	-	6[illegible]
Σ zus.	-	7	-	-	-	-	-	-	-	-	[illegible]
♂♂	-	13	7	2	2	4	2	10	-	-	4[illegible]
♀♀	-	1	-	-	-	1	-	4	-	-	[illegible]
Mark.	-	13	7	2	2	5	2	14	-	-	4[illegible]
W.f.	-	4	-	-	-	-	-	1	-	-	[illegible]

Wiederfang-Quote: durchschnittlich, drei der WaS-Wiederfänge 1988 erfolgten nach 1 Tag (♂♂) und sind somit nicht als Hinweis auf Ortstreue zu werten. Auch die übrigen Verweildauern liegen auf relativ niedrigem Niveau: Ein ♂ nach 3 Tagen (WaS) und ein ♀ nach 2 Tagen (HW).
Distanzen: 3-4
Larvalökologie: durch die Raupenfutterpflanzen mehr ans Offenland gebunden als die vorigen Arten.
Populationsbiologie: deutlich proterandrisch
Verbreitungsstrategie: r-Stratege, 3. Gruppe; das Häufigkeitsmuster innerhalb des Lichtfallennetzes entspricht auch hier den typischen Wanderfaltern, das Auftreten ist oft mit den Wanderfalternächten korreliert, und es waren, vor allem an HW z.T. starke Nacht-zu-Nacht-Fluktuationen festzustellen, was vielleicht als Hinweis auf erhöhte Dispersionsaktivitäten gelten mag.

Rusina ferruginea

siehe Fernwiederfänge (8.2.), verringerte Fallendistanzen (8.3.) und Versetzexperiment (8.4.)

559 Individuen   23,3 % ♀-Rate

493 Markiert   21 Wiederfänge

Tab. 84: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Rusina ferruginea*.

1987	SIEDLUNG		WALD				HALBTROK-KENRASEN			"DACH. MOOS"	Σ
			Garten								
	SIS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	13	1	7	7	17	57	30	1	8	52	193
Σ zus.	-	-	3	20	-	32	26	-	6	-	87
♂♂	2	-	5	20	11	51	40	1	6	32	168
♀♀	11	1	3	4	6	26	15	-	7	11	84
Mark.	13	1	8	23	16	72	51	1	10	34	229
W.f.	-	-	-	-	-	1	-	-	-	1	2

1988	WALD					HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	Garten		Wasserwerk								
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	11	23	31	58	43	39	6	6	2	14	233
Σ zus.	-	46	-	-	-	-	-	-	-	-	46
♂♂	8	59	21	55	39	35	3	3	2	13	228
♀♀	3	10	7	2	4	4	3	2	-	1	36
Mark.	9	69	25	55	41	38	6	5	2	14	264
W.f.	1	14	-	2	-	1	-	1	-	-	19

Wiederfang-Quote: relativ niedrig, vor allem im Ort (1988). Hier liegen auch die Verweildauern auf dem niedrigst möglichen Niveau (1,0 Tage). Ein im Moos 1987 nach 8 Tagen wiedergefangenes ♂ weist vielleicht auf größere Ortstreue in den Moorbirkenwäldchen hin; der Fang erfolgte dort zur Flugzeit nur wöchentlich, sonst wäre dort die Wiederfang-Quote wohl höher ausgefallen.
Die ♀♀ sind im Wiederfangergebnis etwas unterrepräsentiert: 1/21 = 4,8 %. Es handelte sich um einen "Ortswechsler" WaS→SiN (30 m) in 3 Tagen.
Distanzen: 3-4
Populationsbiologie: proterandrisch
Verbreitungsstrategie: r-Stratege, 2. Gruppe; es scheinen dennoch Barrieren gegen die freie Mobilität dieser Art zu existieren: Das polarisierte Häufigkeitsverhältnis SiN/WaN zeigt beispielsweise, daß *R. ferruginea* den Schutz von Gebüschen und Bäumen bevorzugt. Biotoptreue bedeutet daher nicht zwangsweise Ortstreue!
Hohe Nacht-zu-Nacht-Fluktuationen deuten auch auf hohe Dispersionsaktivitäten hin.

Talpophila matura

21 Individuen   13,3 % ♀-Rate

15 Markiert   1 Wiederfang

Wiederfang-Quote: hoch, bei einer allerdings kurzen Verweilzeit von 2 Tagen (ein ♂ am Standort HW); Stichprobe noch zu klein
Distanzen: 2; bisher nur an HM und HW festgestellt, die Distanz zu den nächstgelegenen anderen Fundorten (1 km) liegt offensichtlich nicht im normalen Bereich der Dispersionsaktivität.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; nach KOCH (1984) treten bei dieser Art starke Häufigkeitsschwankungen auf, was eigentlich ein Kennzeichen von r-Strategen ist. Es ist durchaus denkbar, daß diese Art in anderen Gebieten unter vielleicht anderen Bedingungen auch eine andere Strategie verfolgt.

Euplexia lucipara (41 Individuen)

Distanzen: 2-3
Larvalökologie: das HM-Stück 1986 (♂) stammt wohl, von den Raupenfutterpflanzen her beurteilt, vom Ruderal (150-300 m entfernt). Die Distanz Wald→Flughafen-Mitte (1 km) wird offensichtlich nicht regelmäßig zurückgelegt. Einen weiteren Hinweis in dieser Richtung stellt wohl der starke Häufigkeitsgradient zwischen WaN und WNo auf einer Strecke von nur 50 m dar.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Phlogophora meticulosa (15 Individuen)

Distanzen: 4
Populationsbiologie: bivoltin
Verbreitungsstrategie: r-Stratege, 1. Gruppe; die Häufigkeitsschwankungen, die an einen Schwarm erinnernden 12 Moos-Exemplare in einer Nacht, sowie das den anderen typischen Wanderfaltern entsprechende Häufigkeitsmuster innerhalb des Fangnetzes sind weitere Hinweise auf eine Charakteristik dieser Art als hochmobil.

Ipimorpha retusa (18 Individuen)

Distanzen: 2-3
Larvalökologie: oligophag an Weiden, Pappeln und Erle. Im Flughafen-Ruderal befindet sich offensichtlich eine relativ stabile Population mit Weide als Lebensgrundlage, die 150-300 m zum Fangplatz HM werden ohne größere Probleme bewältigt (3♂♂).
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Ipimorpha subtusa (1 Individuum)

Distanzen: 1-2
Larvalökologie: die Raupen sind auf Arten der Gattung *Populus* spezialisiert. Bisher konnten keine biotopfremden Tiere nachgewiesen werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; im Zusammenhang mit der stärkeren Futterpflanzenspeziaisierung im Vergleich zu *I. retusa* scheint diese Art auch eine etwas andere Strategie zu verfolgen.

Enargia paleacea

Distanzen: vermutlich 2-3
Larvalökologie: oligophag an Birke, Pappelarten und Erle
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Enargia ipsilon (3 Individuen)

Distanzen: vermutlich 2-3
Larvalökologie: die Raupe lebt an Pappelarten und an Bruchweide (*Salix fragilis*). Bisher konnten keine biotopfremden Tiere festgestellt werden.
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Cosmia affinis

Distanzen: 2; der sehr lokalen Verbreitung in Südbayern entspricht das lokale Vorkommen im Untersuchungsgebiet: Die Art konnte bisher nur im Korbinianiholz nachgewiesen werden, die Gebiete außerhalb davon liegen wohl auch nicht im Bereich der normalen Dispersionsaktivität.
Larvalökologie: auf Ulmenarten spezialisiert
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Cosmia trapezina

245 Individuen   24,3 % ♀- Rate

177 Markiert   7 Wiederfänge

Tab. 85: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Cosmia trapezina*.

1987	SIEDLUNG		Garten		WALD		HALBTROKKENRASEN			"DACH, MOOS"	Σ
	SIS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	3	-	1	30	5	5	17	-	2	21	84
Σ zus.	-	-	5	5	-	-	1	-	-	3	14
♂♂	2	-	4	26	2	3	8	-	1	7	53
♀♀	1	-	1	4	2	1	8	-	-	8	25
Mark.	2	-	5	30	4	4	15	-	1	14	75
W.f.	-	-	1	-	-	-	-	-	-	-	1

1988	Garten		WALD Wasserwerk			HALBTROKKENRASEN			"DACH. MOOS"	
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We
Σ par.	5	40	6	5	11	18	-	5	6	11
Σ zus.	-	40	-	-	-	-	-	-	-	-
♂♂	4	47	5	4	6	10	-	3	1	4
♀♀	-	8	-	-	2	4	-	2	-	3
Mark.	4	54	5	4	8	14	-	5	1	7
W.f.	-	6	-	-	-	-	-	-	-	-

Wiederfang-Quote: sehr niedrig! Sämtliche Wiederfänge erfolgten nach Intervallen von nur 1 Tag und sind somit keine Hinweise auf Ortstreue. Das 1987 im Garten rückgefangene Tier war ein "Ortswechsler" WaS→SiN (1 Tag). Auch die Wiederfang-Quote von 11 % bei täglichem Fang und die Tatsache, daß kein Zweitwiederfang stattfand, zeugen von einem schnellen Verschwinden aus der näheren Umgebung.
Distanzen: im Habitat 3 (-4?), außerhalb 1-2

Larvalökologie: die Raupe lebt polyphag an Laubbäumen, dementsprechend wurde im reinen Offenland (HM) bisher noch kein Exemplar festgestellt.
Populationsbiologie: deutlich proterandrisch
Verbreitungsstrategie: r-Stratege, 5. Gruppe; auch hier zeigt sich, daß Biotoptreue und Ortstreue nicht gekoppelt sein müssen.

Cosmia pyralina (37 Individuen)

Distanzen: Verhältnisse wahrscheinlich wie bei der vorigen Art
Larvalökologie: polyphag an Laubbäumen, auch hier konnte an HM bisher kein Exemplar festgestellt werden.
Verbreitungsstrategie: r-Stratege, 5. Gruppe

Auchmis comma (4 Individuen)

Distanzen: 2-3
Larvalökologie: monophag an Berberitze (*Berberis vulgaris*); für die Exemplare, die im Siedlungsgebiet nachgewiesen wurden, dienten die desöfteren in Gärten angepflanzten Berberitzen als Lebensgrundlage. Es existiert zusammen mit den im Bereich der Kiefern-Eichen-Wälder eingestreuten Büschen ein Futterpflanzennetz mit Abständen von ca. 100 m.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Actinotia polyodon (4 Individuen)

Distanzen: vermutlich 3
Larvalökologie: die Raupe lebt an Johanniskraut (*Hypericum*) und Tragant (*Astragalus*). Das HM-Stück (♂) ist also mindestens vom Ruderal her (150-300 m) zugeflogen.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Actinotia hyperici (1 Individuum)

Distanzen: vermutlich 2-3
Larvalökologie: monophag an *Hypericum perforatum*
Populationsbiologie: bivoltin
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe; die sehr lokale Verbreitung in Südbayern und das Auffinden dieser Art nur im typischen Biotop (trockene heiße Stellen) lassen an geringe Dispersionsaktivitäten dieser Art unter den gegebenen Bedingungen im Untersuchungsgebiet denken. Dies dient dazu, nicht zufällig in ungeeignete Biotope zu gelangen und somit die Fortpflanzungswahrscheinlichkeit drastisch herabzusetzen. Die Gefahr eines solchen Ereignisses ist bei relativ stenöken Bewohnern seltener Biotoptypen am größten.
An anderen Stellen, vor allem südlich der Alpen, wo geeignete Habitate in weitaus größerer Anzahl zur Verfügung stehen wird die Strategie dementsprechend angepaßt sein.

Apamea monoglypha

70 Individuen 17,6 % ♀- Rate

68 Markiert 2 Wiederfänge

Wiederfang-Quote: sehr niedrig! Beide Wiederfänge (♂♂) erfolgten 1988 im Garten (WaS) nach 1 Tag, sind also auf ein Festhalten durch die direkte Lichtwirkung bei täglichem Fang zurückzuführen. Es sind auch die vergleichsweise niedrige Wiederfang-Quote von 9,5 % und die fehlenden Zweitwiederfänge an diesem Standort bemerkenswert.
Distanzen: 4
Populationsbiologie: proterandrisch
Verbreitungsstrategie: r-Stratege, 1. Gruppe; es handelt sich hier allerdings nicht um einen "klassischen" Vertreter aus der Gruppe der Wanderfalter, eine Korrelation des Auftretens mit den sogenannten Wanderfalternächten war jedoch zu beobachten.

Apamea lithoxylea (1 Individuum)

Distanzen: vermutlich 3
Verbreitungsstrategie: vermutlich r-Stratege, 3. Gruppe

Apamea sublustris

52 Individuen   10,2 % ♀-Rate

47 Markiert   2 Wiederfänge

Wiederfang-Quote: standortabhängig: am Flughafen niedrig, im Wasserwerk relativ hoch, die Einzel-Stichproben sind noch zu klein.
Ein Ortswiederfang im Garten 1988 (♂) nach 1 Tag erklärt sich durch ein Festgehalten-Werden am Licht bei täglichem Fang. Interessanter ist dagegen ein ♂, das im Wasserwerk nach 5 Tagen wiedergefunden wurde; es war von WNw nach WaN (100 m) geflogen. Im Wasserwerk wurden 1988 insgesamt nur 3 Individuen markiert! Hier könnte eine erhöhte Ortsfestigkeit vorliegen, die ihren Ursprung in der relativ isolierten Lage des Biotops hat.
Distanzen: 2-3; die im Garten vereinzelt nachzuweisenden Stücke sind wohl zugeflogen, die 1988 festgestellte größere Anzahl dagegen könnte auf eine erfolgreiche "Brut" zurückzuführen sein, zumal am Licht auch sehr frische Exemplare auftauchten.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Apamea crenata (17 Individuen)

Distanzen: 3
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Apamea characterea (13 Individuen)

Distanzen: 2-3
Larvalökologie: die Raupen dieser Art sind nach KOCH (1984) mehr auf Waldgräsern und unter anderem auch auf Schilf zu finden. Die beiden HM-Stücke (♂♀) stammen daher vielleicht aus dem Ruderal (150-300 m).
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Apamea lateritia (1 Individuum)

Distanzen: vermutlich 4
Verbreitungsstrategie: vermutlich r-Stratege, 3. Gruppe

Apamea remissa (38 Individuen)

Distanzen: 3 ; die in der Siedlung festgestellten 3 Stücke sind wohl von den Verbreitungszentren (Flughafen, Wasserwerk und ähnliche Trockengrasbiotope) her zugeflogen, also ca. 1 km weit.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Apamea unanimis (7 Individuen)

Distanzen: 2-3
Larvalökologie: oligophag an Glanzgras (*Phalaris arundinacea*) und selten an Schilf (*Phragmites "australis"*). Das HM-Stück (♂) stammt daher zumindest aus dem Ruderal (150-300 m), das ♂ am Standort HO vom Schloßkanal, der Falter an HW vom Würmkanal (je ca. 200 m), und schließlich mußten auch die 5 Exemplare, die im Garten beobachtet wurden, vom Ort ihrer Entwicklung aus mindestens 200 m zurückgelegt haben.
Das 1989 im Wasserwerk (WaN) beobachtete ♂ zeugt von einer Flugdistanz (Kolonisation?) von mindestens 700 m.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Apamea anceps

siehe verringerte Fallendistanzen (8.3.)

244 Individuen   19,3 % ♀-Rate

154 Markiert   5 Wiederfänge

Tab. 86: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Apamea anceps*; die Art wurde 1987 nicht markiert.

1988	Garten		WALD Wasserwerk			HALBTROK-KENRASEN			DACH. MOOS		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	-	2	72	9	37	2	5	37	1	-	165
♂♂	-	2	53	7	29	1	4	33	1	-	130
♀♀	-	-	16	2	7	1	1	4	-	-	31
Mark.	-	2	66	9	35	2	5	34	1	-	154
W.f.	-	1	2	-	-	-	-	2	-	-	5

Wiederfang-Quote: durchschnittlich, lediglich das Wiederfang-Ergebnis am Standort HW ist als überdurchschnittlich zu bewerten. Es handelt sich dort um zwei ♂♂, die nach jeweils 4 Tagen rückgefangen wurden. Im Garten (WaS), wo *A. anceps* vermutlich nur als Gast auftritt, wurde ein ♂ durch die Lichtwirkung einen Tag lang festgehalten.
Distanzen: 3
Populationsbiologie: proterandrisch
Verbreitungsstrategie: r-Stratege, 3. Gruppe; das Häufigkeitsmuster im Fangnetz des Untersuchungsgebietes ähnelt dem der typischen Wanderfalter.

Apamea sordens (84 Individuen)

Distanzen: 3
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Apamea scolopacina (35 Individuen)

Distanzen: 2-3
Larvalökologie: die Raupe lebt an einer Reihe von Gräsern, die bevorzugt in Wäldern wachsen. Davon leitet sich auch die ökologische Charakteristik der Imagines ab. Dementsprechend konnte im reinen Offenland (HM) die Art nicht nachgewiesen werden, die Distanz von 1 km über biotopfremdes Gebiet scheint nicht im Bereich der normalen Dispersionsaktivität zu liegen.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; im Verlauf dieses Jahrhunderts hat offensichtlich eine Besiedlung des südbayerischen Faunengebiets stattgefunden. Hierbei mußten mindestens 2 km pro Jahr zurückgelegt worden sein, denkbar wäre jedoch auch ein einmaliger größerer Vorstoß.

Apamea ophiogramma (5 Individuen)

Distanzen: 2-3
Larvalökologie: oligophag an einer Reihe von hygrophilen Pflanzen, v.a. an Schilf. Das WNw-Stück (♂) mußte ca. 100 m von der nächstgelegenen Futterpflanze her geflogen sein, interessant ist jedoch vor allem die (wahrscheinlich) erfolgreiche Kolonisation des Wasserwerkgeländes schon 2-3 Jahre nach dem ersten Auftauchen der Raupenfutterpflanzen über 1 km biotopfremdes Gebiet hinweg.
In der Siedlung bildet die Begleitvegetation der Gartenteiche die Lebensgrundlage, die beiden HO-♂♂ zeigen, daß auch 200 m Distanz durch Waldgebiet hindurch (Strecke Schloßkanal→ HO) bewältigt werden. Das HW-Stück stammt vom Würmkanal (ca. 100-150 m).
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Oligia strigilis (206 Individuen)

Distanzen: 3
Larvalökologie: an Gräsern, aber wie alle Oligien im Moos und im Waldinneren seltener. Der Einflug über Distanzen von 1-3 km scheint hier relativ ineffizient zu sein.
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Oligia versicolor (55 Individuen)

Distanzen: 2-3
Larvalökologie: im Vergleich zu den beiden anderen *Oligia*-Arten ist *O. versicolor* noch am ehesten in der Lage, feuchte und stark bewaldete Biotope zu besiedeln.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Oligia latruncula

497 Individuen	45,5 % ♀-Rate
31 Markiert	kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe jedoch noch zu klein; die 31 Markierungen erfolgten alle 1988 im Wasserwerk.
Distanzen: 3-4
Larvalökologie: die Raupe lebt an Gräsern und findet wohl überall eine Lebensgrundlage.
Verbreitungsstrategie: r-Stratege, 3. Gruppe; dies ist ein Beispiel dafür, daß sich durchaus auch kleine Arten eine r-Strategie zueigen gemacht haben.

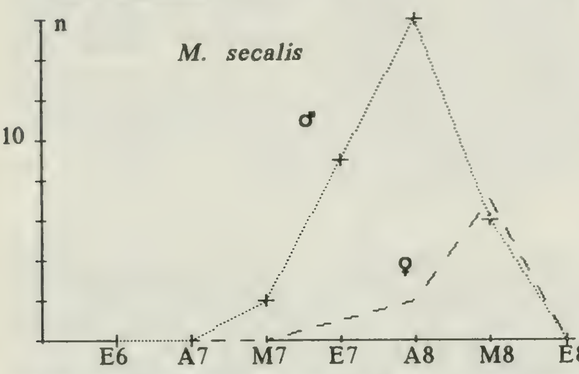
Miana furuncula (64 Individuen)

Distanzen: 3; der drastische Häufigkeitsabfall von WaN nach WNw auf einer Strekke von 100 m weist auf Barrieren gegen eine freie Beweglichkeit bei dieser Art hin. Ein solches Hindernis stellen bei *M. furuncula* anscheinend feuchte Waldgebiete bzw. -ränder dar.
Larvalökologie: an verschiedenen Gräsern, die Art scheint lediglich in den etwas feuchteren Wäldern keine Lebensgrundlage zu finden.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Mesapamea secalis

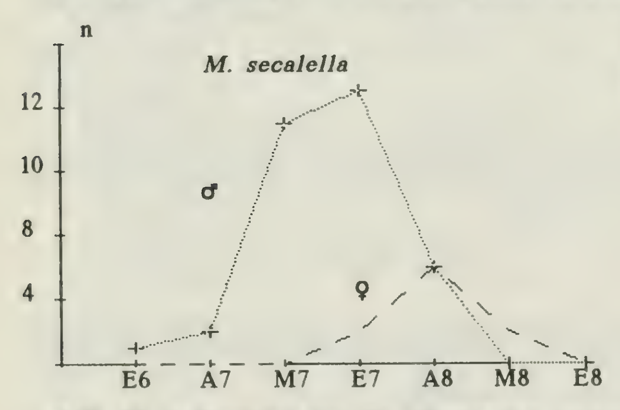
63 Individuen 28,3 % ♀-Rate

Distanzen: 4
Larvalökologie: die Raupen dieser und der folgenden Art leben an Gräsern, vor allem an Getreide; so finden die *Mesapamea*-Arten so gut wie überall eine Lebensgrundlage, lediglich das Waldinnere, insbesondere von feuchteren Wäldern scheint die Art tendenziell zu meiden.
Populationsbiologie: stark proterandrisch; dies ermöglicht der Art, zumindest in manchen Jahren eine relativ gute Trennung des Fortpflanzungsgeschehens mit dem der folgenden Art:



Es ist gut ersichtlich, daß Anfang August 1988 für die *secalis*-♂♂ das Flugmaximum mit dem Zeitpunkt zusammenfiel, an dem verstärkt ♀♀ emergierten. Für die Gewährleistung einer möglichst reibungslosen Befruchtung ist es von Vorteil, wenn schon alle ♂♂ vorhanden sind und sozusagen nur darauf warten, ein befruchtungsfähiges ♀ zu finden.

Abb. 44: Anflugdiagramm für *Mesapamea secalis* 1988.



Dieser Zeitpunkt lag, wie aus dem zweiten Flugdiagramm zu entnehmen ist, bei *Mesapamea secalella* 1988 1-2 Dekaden früher, nämlich Mitte bis Ende Juli.

Abb. 45: Anflugdiagramm für *Mesapamea secalella* 1988.

Verbreitungsstrategie: r-Stratege, 3. Gruppe; diese Art unterliegt, wie auch die folgende, starken Häufigkeitsschwankungen, was als Hinweis auf starke Dispersionsaktivitäten gewertet werden kann. Das Auftreten ist darüber hinaus in einer besonderen Weise mit den Wanderfalternächten korreliert.

Mesapamea secalella

69 Individuen 25,0 % ♀-Rate

Distanzen: 4
Larvalökologie: wie *M. secalis*
Populationsbiologie: siehe vorhergehende Art
Verbreitungsstrategie: r-Stratege, 3. Gruppe; siehe Hinweise zu *M. secalis*

Photedes minima (25 Individuen)

Distanzen: 1-2; außerhalb der Moorbirkenwäldchen nur in einem Exemplar an HW; dieses ♂ könnte von den feuchteren Stellen am Würmkanal stammen (an der kürzesten Stelle 150 m entfernt).
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Photedes extrema (11 Individuen)

Distanzen: 2; die Distanz von 1 km, die bei einem (nicht festgestellten) Zuflug in den Ort bewältigt werden müßte, liegt nicht im Bereich der normalen Dispersionsaktivität. Die Kolonisation des Wasserwerks setzt jedoch Trittsteinsprünge von mindestens 100-300 m voraus.
Larvalökologie: die Raupe lebt monophag an Land-Reitgras (*Calamagrostis epigejos*); die beiden HM-Stücke stammen daher mit ziemlicher Sicherheit aus dem Ruderal, die nächstgelegenen Standorte der Futterpflanze liegen ca. 150 m entfernt.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Photedes fluxa (67 Individuen)

Distanzen: 3
Larvalökologie: wie die vorige Art monophag an Land-Reitgras, die Imagines sind jedoch ungleich weiter verbreitet. Die 6 Exemplare an HM (aus dem Ruderal, 150-300 m) sowie die vereinzelt im Garten anfliegenden Stücke, die aus mindestens 200 m Entfernung stammen (auch ♀♀), zeigen, daß derartige Distanzen zur normalen Dispersionsaktivität dieser Art gehören.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Photedes pygmina

Distanzen: 2
Verbreitungsstrategie: K-Stratege, 6. Gruppe (siehe SPITZER et al., 1984)

Luperina testacea

94 Individuen 17,4 % ♀- Rate

86 markiert 2 Wiederfänge

Wiederfang-Quote: relativ niedrig: 1988 wurde im Garten (WaS) von 13 markierten Faltern ein ♂ durch die Lichtwirkung einen Tag lang festgehalten, 1987 erfolgte ein regulärer Wiederfang (SiN) eines ♂ nach 2 Tagen.
Distanzen: 3
Larvalökologie: die Raupe lebt an Gräsern
Populationsbiologie: proterandrisch
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Amphipoea oculea (2 Individuen)

Distanzen: vermutlich 2-3
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Amphipoea fucosa (180 Individuen)

Distanzen: 3; das stark polarisierte Häufigkeitsverhältnis WaN/WNw auf einer Strecke von 100 m deutet auf Barrieren gegen eine freie Dispersionsaktivität hin.
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Amphipoea lucens (1 Individuum)

Distanzen: 1-2
Larvalökologie: die Raupe lebt nach KOCH (1984) an "Gräsern, mutmaßlich an Pfeifengras (*Molinia caerulea*)". Diese Raupenfutterpflanze kommt im Wasserwerk am Fundort WNo vor.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Hydraecia micacea (37 Individuen)

Distanzen: 3
Larvalökologie: die Raupe lebt oligophag an einer Reihe mehr oder weniger feuchtigkeitsliebender Pflanzen. Die im Garten festgestellten 6 Exemplare sind offensichtlich zugeflogen. Der nächstliegende Bestand einer der von KOCH (1984) genannten Futterpflanzen liegt ca. 200 m entfernt. In den letzten beiden Jahren waren an verschiedenen Gartenteichen der näheren Umgebung erstmals Schwertlilien (*Iris*) festzustellen; dies könnte zu einer Kolonisation geführt haben und würde das verstärkte Auftreten 1988 im Garten erklären.
Das HM-Stück (♂) stammt wohl aus dem Ruderal (150-300 m entfernt).
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Gortyna flavago (9 Individuen)

Distanzen: 2-3; der starke Häufigkeitsgradient im Wasserwerk könnte auf geringe Dispersionsaktivitäten dieser Art hindeuten.
Larvalökologie: von den in KOCH (1984) genannten Raupenfutterpflanzen wächst in der näheren Umgebung des Gartens keine. Das 1986 nachgewiesene ♂ ist daher vermutlich vom Rand des Berglwaldes her zugeflogen (mindestens 150-200 m).
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Celaena leucostigma (1 Individuum)

Distanzen: vermutlich 2-3; manchmal 4 (EITSCHBERGER & STEINIGER, 1980)
Larvalökologie: die Raupe lebt oligophag an einigen hygrophilen Pflanzen, die alle nicht am Fundort WaM vorkommen. Das ♂ ist vermutlich vom 150 m entfernten Berglbach her zugeflogen. Die Strecke ist bewaldet, der Flug erfolgte nicht aufgrund der Lichtattraktion, da durch eine hohe Gebüschzeile der direkte Lichteinfluß erst unmittelbar vor der Falle zum Tragen kam.
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Nonagria typhae (10 Individuen, dazu eine größere Anzahl von Exuvien)

Distanzen: 1-3; im Wasserwerk weist der starke Häufigkeitsgradient auf eine geringe Mobilität hin.
Larvalökologie: die Raupe frißt Teichkolben (*Typha*) und Teichsimse (*Schoenoplectus lacustris*). Am Standort WNo, wo sich ein kleiner Bestand von Teichkolben befindet, ist eine kleine Population von *N. typhae* bodenständig, wie durch Exuvienfunde bestätigt wurde. 1988 konnte trotz 10 an WNo festgestellten Imagines kein Exemplar beobachtet werden, das die Distanzen von 50 bzw. 120 m an die beiden anderen Fallen-Standorte im Wasserwerk bewältigt hätte.
Andererseits wurden am Franzosenhölzl 1989 2 Exemplare (♂♀) gangen, die sich ohne Sichtkontakt zur Lichtquelle 40 m weit von den Teichkolben-Beständen entfernt hatten. Denkbar sind als Erklärung aber auch zwei unterschiedliche Flugtypen: Vielleicht ist die Anziehungskraft des Lichts auf Tiere, die sich auf "Fernflügen" (Dispersion) befinden, geringer als auf solche im trivial movement.
Der Teichkolbenbestand befindet sich erst seit 2-3 Jahren an dieser Stelle. Es mußte in diesem Zeitraum eine Kolonisation aus über 1 km Entfernung, dem nächsten Vorkommen der Raupenfutterpflanze, stattgefunden haben. Ähnlich schnelle Kolonisationen über vergleichbare Distanzen ergeben sich auch bei der Auswertung der weiteren Standorte, wo Exuvien gefunden wurden (neuangelegte Teiche im Flughafengebiet und am Franzosenhölzl im Dachauer Moos).
Populationsbiologie: am Standort WNo, wo ca. 500 *Typha*-Halme stehen, wurden mit Exuvien besetzte Pflanzen ausgezählt: Auf ca 15 Halme war ein besetzter zu finden (n = ca. 100). Auf den gesamten *Typha*-Bestand zurückgerechnet ergäben sich 33 im Jahr 1988 emergierte Falter. Nur ca. 1/3 davon wurde am Licht nachgewiesen. Dies ist wohl vor allem durch nicht optimales Anflugverhalten bedingt; weitere Gründe können rasche Mortalität vor der nächsten Möglichkeit, die geschlüpften Tiere zu erfassen, sowie ein schnelles Abwandern mancher Exemplare sein.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; die Erschließung neuer Habitate, die recht schnell erfolgen kann, erfolgt durch Individuen mit höherer Dispersionsaktivität, die entweder bei einer starken Vermehrung eines Bestandes abwandern oder bei einer Vernichtung der Lebensgrundlage (z.B. einem Trockenfallen eines Feuchtgebietes oder einer Vernichtung durch Baumaßnahmen) gezwungen sind, den Standort zu verlassen.

Nonagria nexa (1 Individuum)

Distanzen: 2-3
Larvalökologie: oligophag an einigen hygrophilen Pflanzen, das HO-Stück (♂) stammt vermutlich vom 200 m entfernten Schloßkanal. Die Flugstrecke führt durch bewaldetes Gelände.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; die Verhältnisse ähneln vermutlich denen bei *N. typhae*. Das nächstgelegene bisher bekannte Vorkommen dieser Art liegt in den Isarauen ca. 7 km östlich von Oberschleißheim. Da das Untersuchungsgebiet um die Jahrhundertwende entomologisch sehr gut durchforscht war, handelt es sich ziemlich sicher um eine Kolonisation über die genannte Mindestdistanz.

Rhizedra lutosa (3 Individuen)

Distanzen: 2
Larvalökologie: monophag an Schilf (*Phragmites "australis"*); die vom Standort HM aus gesehen nächsten Schilfvorkommen liegen im Ruderal ca. 200 m entfernt. Diese Distanz wird mit erstaunlicher Konstanz bewältigt (auch ein ♀). Jedoch schon für die Strecke von 1,2 km nach HO konnte kein Flugnachweis erbracht werden. Das an HW gefundene ♀ stammt mindestens aus einer Entfernung von 150 m (Würmkanal) ohne Sichtkontakt zur Lichtquelle.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; die Strategie dürfte der bei *N. typhae* besprochenen ähneln.



Abb. 45b: Nonagria typhae ♂ (WNo, 28.9.88), ein Vertreter aus der Gruppe der sogenannten Schilf- bzw. Röhrichteulen an der Raupenfutterpflanze Typha latifolia.

Meristis trigrammica

siehe Fernwiederfänge (8.2.) und Versetzexperiment (8.4.)

300 Individuen 7,5 % ♀-Rate

290 markiert 65 Wiederfänge

Tab. 87: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Meristis trigrammica.*

1987	SIEDLUNG		SIEDLUNG / WALD: Garten		WALD		HALBTROKKENRASEN			"DACHMOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	-	2	16	6	1	-	20	25	4	-	74
Σ zus.	-	-	1	31	-	-	1	-	1	-	34
♂♂	-	1	15	32	1	-	19	20	5	-	93
♀♀	-	1	1	4	-	-	1	4	-	-	11
Mark.	-	2	16	35	1	-	20	24	5	-	103
W.f.	-	-	1	1	-	-	-	-	-	-	2

1988	WALD: Garten		WALD: Wasserwerk			HALBTROKKENRASEN			"DACHMOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	27	30	4	5	10	33	30	11	-	1	151
Σ zus.	-	41	-	-	-	-	-	-	-	-	41
♂♂	23	66	4	5	10	30	29	10	-	1	178
♀♀	1	5	-	-	-	3	1	1	-	-	11
Mark.	24	70	2	5	10	33	30	11	-	1	187
W.f.	4	54	1	-	-	4	-	-	-	-	63

Wiederfang-Quote: standortabhängig: Im Garten und an HO meist hoch, sonst eher niedrig. An HO wurden 1988 drei ♂♂ nach 2 Tagen, eines erst nach 6 Tagen wiedergefangen. Die mittlere Verweildauer im Garten 1988 betrug (bei anderer Methodik) 3,0 Tage, was verglichen mit anderen Arten einen langen Zeitraum bedeutet.
Distanzen: 2–3
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; einer gewissen Ortstreue zumindest von Teilen der jeweiligen Populationen in Eichenwäldern steht eine erhöhte Beweglichkeit an den anderen Standorten gegenüber. Im Offenland (HM) sind überdies starke Nacht-zu-Nacht-Fluktuationen ein weiteres Indiz für starke Dispersionsaktivitäten: So wurden am 30.5.88 14 Individuen und am 26.5.86 gar 24 Exemplare gefangen; in beiden Fällen erbrachten die Fangnächte davor und danach kein einziges Stück.

Hoplodrina alsines

siehe Fernwiederfänge (8.2.) und Versetzexperiment (8.4.)

706 Individuen 14,7 % ♀-Rate

635 markiert 43 Wiederfänge

Tab. 88: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Hoplodrina alsines.*

1987	SIEDLUNG		SIEDLUNG / WALD: Garten		WALD		HALBTROKKENRASEN			"DACHMOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	9	10	20	64	15	83	26	7	15	2	251
Σ zus.	-	3	1	48	-	6	13	1	10	-	82
♂♂	7	9	16	79	14	66	29	6	14	2	242
♀♀	1	3	2	26	1	14	5	1	4	-	57
Mark.	7	10	17	103	15	78	34	7	16	2	289
W.f.	-	-	2	3	-	1	-	-	-	-	6

1988	WALD: Garten		WALD: Wasserwerk			HALBTROKKENRASEN			"DACHMOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	24	69	32	11	30	15	8	17	5	1	2
Σ zus.	-	161	-	-	-	-	-	-	-	-	1
♂♂	22	187	20	11	28	14	8	17	5	1	3
♀♀	1	25	10	-	2	1	-	-	-	-	
Mark.	22	211	30	11	27	14	8	17	5	1	3
W.f.	1	30	1	-	4	1	-	-	-	-	

Wiederfang-Quote: durchschnittlich, im Wasserwerk 1988 mit 5,9 % Ortswiederfängen vergleichsweise hoch. Es handelte sich dort um 4 ♂♂ mit einer relativ niedrigen mittleren Verweildauer von 2,8 Tagen. Auch im Garten 1988 lagen (bei anderer Methodik) die Verweilzeiten bei einem Mittel von 2,2 Tagen in einem nicht als hoch zu bezeichnenden Bereich. Das Maximum eines nach 9 Tagen wiedergefangenen ♂ zeigt, daß durchaus einzelne Exemplare der Population ortstreu sein können.
Die ♀♀ sind im Wiederfangergebnis mit 1/43 = 2,3 % deutlich unterrepräsentiert.
Distanzen: 3–4; die Fernwiederfänge, sowie die Tatsache, daß im Versetzexperiment und im Wasserwerk die Distanzen von 120 m mühelos bewältigt wurden, deuten auf hohe Dispersionsaktivitäten des Großteils der Population hin.
Larvalökologie: die Art findet wohl überall, wo niedrige Pflanzen wachsen, eine Lebensgrundlage.
Populationsbiologie: stark proterandrisch (im Gegensatz zu den Angaben in NOWAK, 1974); die ♀♀ scheinen an bestimmten Stellen bevorzugt aufzutreten: Die ♀-Rate war an WaS stets 2–3mal so hoch wie am 30 m entfernten Standort SiN, ein ähnliches Phänomen zeigte sich im Wasserwerk 1988 auf einer Strecke von 100 m (WaN/WNw). Vielleicht erleichtert ein solches Verhalten das Sich-Auffinden der Geschlechtspartner ("mating sites").
Verbreitungsstrategie: r-Stratege, 2. Gruppe

Hoplodrina blanda (26 Individuen)

Distanzen: 2-3; *H. blanda* scheint im Untersuchungsgebiet weniger dispersionsaktiv zu sein als die vorige Art. Hinweise darauf sind der bisher fehlende Nachweis an HM und das stark polarisierte Häufigkeitsverhältnis zwischen den Standorten WaN und WNo auf einer Strecke von nur 50 m.
Verbreitungsstrategie: intermediärer Typ, 1. Gruppe

Hoplodrina ambigua (119 Individuen)

Distanzen: 3-4
Larvalökologie: *H. ambigua* findet wohl überall eine Lebensgrundlage. Im Inneren der Wälder wurde die Art jedoch bisher noch nie festgestellt.
Populationsbiologie: bivoltin
Verbreitungsstrategie: r-Stratege, 5. Gruppe; die Häufigkeitsschwankungen und das Häufigkeitsmuster innerhalb des Fangstellennetzes, das dem der Wanderfalter entspricht, können als Hinweise auf hohe Dispersionsaktivitäten verstanden werden. *H. ambigua* hat im südbayerischen Raum im Lauf dieses Jahrhunderts größere Arealausweitungen unternommen. Regelmäßige Mindest-Flugleistungen von 1-2 km/Generation sind hierbei zu postulieren.

Atypha pulmonaris (5 Indviduen)

Distanzen: 2-3
Larvalökologie: die Raupe dieses an feuchtwarme Standorte gebundenen Eulenfalters lebt an Lungenkraut (*Pulmonaria*) und an Beinwell (*Symphytum officinale*); das HM-Stück (♂) stammt daher vermutlich vom Ruderal (150-300 m), das Exemplar im Garten (♂) zumindest vom Berglwaldrand (150 m).
Verbreitungsstrategie: K-Stratege, 5. Gruppe

Spodoptera exigua (2 Individuen)

Distanzen: 4
Verbreitungsstrategie: r-Stratege, 1. Gruppe

Caradrina morpheus

503 Individuen 8,9 % ♀- Rate

396 markiert 19 Wiederfänge

Tab. 89: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Caradrina morpheus*.

1987	SIEDLUNG		Garten		WALD		HALBTROKKENRASEN			"DACHMOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	7	20	26	32	6	46	27	3	16	3	186
Σ zus.	-	2	-	8	-	8	26	3	20	-	67
♂♂	5	15	17	32	3	35	38	5	18	2	170
♀♀	-	2	4	4	-	4	7	1	5	-	27
Mark.	4	16	21	35	3	39	43	6	23	2	192
W.f.	-	-	-	1	-	-	-	-	-	-	1

1988	Garten		WALD Wasserwerk			HALBTROKKENRASEN			"DACHMOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	20	45	23	25	40	14	2	8	-	2	179
Σ zus.	-	71	-	-	-	-	-	-	-	-	71
♂♂	14	94	14	20	36	11	2	7	-	1	199
♀♀	2	3	3	-	1	-	-	-	-	-	9
Mark.	15	96	17	18	37	11	2	7	-	1	204
W.f.	-	16	-	2	-	-	-	-	-	-	18

Wiederfang-Quote: niedrig! 1987 erfolgte der einzige Wiederfang schon nach 1 Tag. Es handelte sich um ein ♂, das von SiN nach WaS (30 m) flog.
Im Wasserwerk wurden 1988 2 ♂♂ nach jeweils 3 Tagen wiedergefangen, was einer durchschnittlichen Wiederfang-Quote von 2,8 % entspricht. Im Garten 1988 wurden 13 ♂♂ nach einem 1-Tages-Intervall und nur 3 ♂♂ nach 2 Tagen rückgefangen; die mittlere Verweilzeit beträgt also nur 1,2 Tage! Zweitwiederfänge ereigneten sich nicht.
Distanzen: 3
Larvalökologie: die an HM festgestellten 10 Exemplare (auch ein ♀) stammen, nach den in KOCH (1984) genannten Raupenfutterpflanzen beurteilt, zumindest vom Ruderal (150-300 m entfernt). Diese Distanzen liegen im normalen Bereich der Dispersionsaktivität dieser Art.
Populationsbiologie: proterandrisch
Verbreitungsstrategie: r-Stratege, 2. Gruppe; im Gegensatz zu den Behauptungen BETTMANNs (1986) handelt es sich im Untersuchungsgebiet um eine recht mobile Art. Starke Nacht-zu-Nacht-Fluktuationen sind vor allem am Flugzeitende zu beobachten.

Paradrina clavipalpis

Distanzen: 4
Verbreitungsstrategie: r-Stratege, 1. Gruppe

Eremodrina gilva (41 Individuen)

Distanzen: 4
Verbreitungsstrategie: r-Stratege, 3. Gruppe; diese ursprünglich alpin verbreitete Art führt seit ca. 1950 eine nach Norden gerichtete Expansion durch. Hierbei müssen zumindest in manchen Jahren Distanzen von über 10 km zurückgelegt worden sein. Die in den letzten Jahren bekanntgewordenen Funde in Mittel- und Norddeutschland lassen aber weit höhere Werte vermuten.
Das Häufigkeitsmuster innerhalb des Fallennetzes entspricht interessanterweise dem der Wanderfalter.

Agrotis venustula (57 Individuen)

Distanzen: 2
Larvalökologie: als Futterpflanzen kommen im Untersuchungsgebiet wohl nur Pfeifengras (*Molinia*) und Frauenmantel (*Alchemilla vulgaris*) in Frage. Die an HW festgestellten Stücke (♂♂) stammen vermutlich vom Würmkanal (mindestens 150 m), dem nächstgelegenen Standort dieser Pflanzen. Es bestand kein Sichtkontakt zur Lichtquelle. Die Distanz von 1 km (Zuflug nach HM) liegt nicht mehr im Bereich der Dispersionsaktivität dieser kleinen Art.
Verbreitungsstrategie: K-Stratege, 5. Gruppe

CUCULLIINAE

Cucullia lucifuga (1 Individuum)

Distanzen: vermutlich 2-3
Populationsbiologie: im Untersuchungsgebiet vermutlich bivoltin
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe; in der unteren Hochebene Südbayerns ist diese Art nur lokal verbreitet.

Cucullia umbratica (11 Individuen)

Distanzen: 2
Larvalökologie: die Puppe überliegt nach KOCH (1984) "oft 1 bis 2 Jahre".
Verbreitungsstrategie: K-Stratege, 4. Gruppe; die lange Entwicklungsdauer erlaubt der Art keine hohe Wachstumsraten der Populationen. GYULAI & VARGA (1974) beschreiben *C. umbratica* allerdings als Wanderfalter.

Cucullia verbasci (viele Raupenfunde)

Distanzen: 2-3
Larvalökologie: die Puppe überliegt nach KOCH (1984) öfters. Die Raupen sind auf Königskerzen (*Verbascum*) und Braunwurz (*Scrophularia nodosa*) spezialisiert.
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe; entsprechend dem relativ unsteten Auftreten der Raupenfutterpflanzen spiegelten die Raupenfunde hohe Austauschraten wieder. Im Garten wurden Raupen beispielsweise vor 1981 vereinzelt, 1982, 1984 und 1985 beobachtet.

Cucullia scrophulariae (2 Individuen, dazu einige Raupenfunde)

Distanzen: vermutlich 2-3
Larvalökologie: wie *C. verbasci*, jedoch vor allem an Mehliger Königskerze (*Verbascum lychnitis*) zu finden
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Calophasia lunula (2 Individuen)

Distanzen: 3-4
Larvalökologie: die Raupen sind stark spezialisiert und fressen an Leinkraut (*Linaria vulgaris, -repens*). Die beiden im Garten festgestellten ♂♂ sind biotopfremd: Im Umkreis von mindestens 300 m existieren keine Vorkommen der Futterpflanzen.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; *C. lunula* war um die Jahrhundertwende herum im Untersuchungsgebiet noch nicht nachgewiesen worden. Erst WOLFSBERGER (1950; 1953/1954) erwähnt für Schleißheim ein häufiges Vorkommen als Raupe in den 50er Jahren sowie eine allgemeine »Ausweitung der Wohnareale«. Ähnliches berichtet LATTIN (1967). Flugleistungen im oben angegebenen Rahmen dürften hierzu die Voraussetzung gewesen sein.

Brachionycha sphinx

73 Individuen	5,3 % ♀-Rate
19 markiert	1 Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein. Es konnte lediglich 1988 im Garten (WaS) ein wegen der Lichtwirkung einen Tag "ortstreu" verbliebenes ♂ rückgefangen werden.
Distanzen: 2-3
Larvalökologie: an verschiedenen Laubgehölzen, das HM-♂ 1987 stammt zumindest aus dem Ruderal (150-300 m).
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Lithophane socia (11 Individuen)

Distanzen: 2
Larvalökologie: an verschiedenen Laubbäumen, bisher konnten keine biotopfremden Tiere festgestellt werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Lithophane ornitopus (1 Individuum)

Distanzen: vermutlich 2
Larvalökologie: wie *L. socia*
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Lithophane furcifera (1 Individuum)

Distanzen: vermutlich 2
Larvalökologie: wie *L. socia*
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Xylena vetusta (7 Individuen)

Distanzen: 2-3
Larvalökologie: das 1988 an HM festgestellte ♂ stammt, nach den Raupenfutterpflanzen beurteilt, vermutlich vom Ruderal (150-300 m entfernt).
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Allophyes oxyacanthae

84 Individuen   11,0 % ♀- Rate

73 markiert   1 Wiederfang

Wiederfang-Quote: niedrig; ein an WaS markiertes ♂ wurde 1987 nach 2 Tagen 30 m entfernt an SiN rückgefangen. 1988 konnte bei täglichem Fang am Standort WaS von 18 markierten Faltern keiner mehr ein zweites Mal gefangen werden!
Distanzen: 3
Larvalökologie: die Raupen leben an Schlehe, Apfel, Weißdorn und Pflaume. Für die drei an HM festgestellten ♂♂ kommen nur eine in ungefähr 350-400 m Entfernung verlaufende Weißdornhecke oder ein ca. 100 m entfernter einzelstehender Busch als Herkunft in Frage. Die Distanz von 350-400 m wird also entweder relativ oft zumindest von ♂♂ bewältigt, oder sie wurde in der Vergangenheit von einem fertilen ♀ zurückgelegt, es kam zu einer Kolonisation des ca. 1 m^3 großen Busches und die Nachkommen wurden dann am Licht nachgewiesen.
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Griposia aprilina (1 Individuum)

Distanzen: vermutlich 2
Larvalökologie: vor allem an Eiche, selten einige andere Laubgehölze; bisher konnten keine biotopfremden Stücke festgestellt werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Blepharita satura

21 Individuen   36,8 % ♀- Rate

19 markiert   kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein
Distanzen: 2-3
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Blepharita adusta

Distanzen: vermutlich 2-3
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Antitype chi (3 Individuen)

Distanzen: vermutlich 2-3
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Eupsilia transversa

66 Individuen 43,8 % ♀-Rate

64 markiert 2 Wiederfänge

Wiederfang-Quote: niedrig, wiedergefangen wurden im Garten (SiN) 1987 bei täglichem Fang 2 ♂♂ nach 1 bzw. 2 Tagen, was keinen Hinweis auf Ortstreue darstellt.
Distanzen: 3
Larvalökologie: die Raupen fressen an Laubhölzern, die 1986 an HM festgestellten Exemplare stammen vermutlich aus dem Ruderal (150-300 m).
Populationsbiologie: proterandrisch
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Conistra vaccinii

78 Individuen 53,2 % ♀-Rate

77 markiert 4 Wiederfänge

Wiederfang-Quote: die Wiederfang-Quote ist als durchschnittlich einzustufen. Die einzelnen Rückmeldungen beziehen sich auf ein ♂ 1987 im Garten, das bei einer Verweildauer von 6 Tagen (bei täglichem Fang!) viermal die Falle anflog. Ein ♀ wurde 1987 an WaS nach 2 Tagen (und dazwischenliegender fangfreier Nacht) wiedergefangen.
Distanzen: 2-3
Larvalökologie: auch die Raupenfutterpflanzen von *C. vaccinii* lassen den Schluß zu, daß das ♂ am Standort HM zumindest vom Ruderal her (150-300 m) zugeflogen sein muß.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Conistra rubiginosa (4 Individuen)

Wiederfang-Quote: 3 Individuen wurden markiert, Wiederfänge waren keine zu verzeichnen.
Distanzen: vermutlich 2
Larvalökologie: die Raupen sind in den ersten Stadien auf Schlehe, Pflaume, Traubenkirsche oder Feld-Ahorn angewiesen. Bisher konnten keine biotopfremden Exemplare nachgewiesen werden.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Agrochola circellaris

15 Individuen 38,5 % ♀-Rate

13 markiert kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein
Distanzen: 2-3
Larvalökologie: im Anfangsstadium leben die Raupen an einer Reihe von Laubbäumen, biotopfremde Exemplare konnten bisher noch nicht festgestellt werden.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Agrochola macilenta

16 Individuen 16,7 % ♀-Rate

12 markiert kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein
Distanzen: 2; zwischen WaS und SiN ist auf einer Strecke von nur 30 m ein deutlicher Häufigkeitsgradient (7:1) festzustellen.
Larvalökologie: wie *A. circellaris*
Verbreitungsstrategie: K-Stratege, 6. Gruppe; *A. macilenta* scheint etwas stärker an bewaldete Strukturen gebunden zu sein als *A. circellaris*. Dies steht wohl auch im Zusammenhang mit dem normalerweise lokalerem Vorkommen von *A. macilenta*.

Agrochola nitida (1 Individuum)

Distanzen: vermutlich 2-3
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Agrochola helvola

8 Individuen 40 % ♀-Rate (Stichprobe zu klein)

5 markiert kein Wiederfang

Wiederfang-Quote: Stichprobe noch zu klein
Distanzen: 2-3
Larvalökologie: wie *A. circellaris*, bevorzugt jedoch Weide. Das HM-Stück 1986 stammt mit großer Wahrscheinlichkeit aus dem Ruderal (150-300 m).
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Agrochola litura

19 Individuen 62,5 % ♀-Rate

16 markiert kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein.
Distanzen: 2-3
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Agrochola lychnidis (4 Individuen)

Wiederfang-Quote: ein am Flügel in charakteristischer Weise leicht deformiertes Exemplar (♂) flog 1988 an WNo 2 Tage nach dem Erstfang die Falle erneut an.
Distanzen: vermutlich 2-3
Larvalökologie: wie *A. circellaris*, das 1986 an HM festgestellte Stück stammte mit großer Wahrscheinlichkeit aus dem Ruderal (150-300 m).
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Agrochola lota

7 Individuen "0 %" ♀-Rate (Stichprobe zu klein)

6 markiert kein Wiederfang

Wiederfang-Quote: Stichprobe zu klein
Distanzen: 2-3
Larvalökologie: die 4 im Garten festgestellten Exemplare sind, nach den in KOCH (1984) genannten Raupenfutterpflanzen beurteilt, aus mindestens 200 m Entfernung zugeflogen. Auch die beiden HW-Stücke stammen wohl vom Würmkanal (150 m entfernt).
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Parastichtis suspecta

Distanzen: 1-2
Larvalökologie: die Raupen sind in den ersten Stadien an Pappelarten gebunden. Das im Garten 1983 nachgewiesene Stück (♀) hatte mindestens 300 m vom nächstgelegenen Standort der Futterpflanze her zurückgelegt. Diese Distanz liegt vielleicht schon im oberen Bereich der Dispersionsaktivitäten dieser Art.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Cirrhia aurago (1 Individuum)

Distanzen: vermutlich 2
Larvalökologie: vor allem an Buche, jedoch auch an Eiche, Linde, Pappel und Weide; bisher konnten keine biotopfremden Tiere festgestellt werden.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Cirrhia togata

30 Individuen 33,3 % ♀-Rate

27 markiert 1 Wiederfang

Wiederfang-Quote: hoch; Stichprobe noch zu klein. 1987 wurde im Wasserwerk (WaN) ein ♂ nach 3 Tagen wiedergefangen.
Distanzen: 1-2
Larvalökologie: in den ersten Larvalstadien an Weidenarten gebunden. Im Wasserwerk spricht der starke Häufigkeitsgradient schon auf einer Distanz von 50 m für Barrieren gegen die freie Beweglichkeit dieser Art. Da an WNo die Falle in einer Weide postiert war, an den beiden anderen Standorten jedoch ca. 10-20 m von der nächstgelegenen entfernt, könnten unter Umständen solch kurze Distanzen bereits nicht mehr zur normalen Dispersionsaktivität dieser Art gehören. Auch die Tatsache, daß *C. togata* im Siedlungsbereich noch nie festgestellt wurde, paßt gut in dieses Bild.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Cirrhia icteritia

16 Individuen 54,5 % ♀-Rate

11 markiert kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein
Distanzen: 2-3
Larvalökologie: die Raupe ist in den ersten Stadien an Sal-Weide (*Salix caprea*), Grau-Weide (*Salix cinerea*) und Espe (*Populus tremula*) gebunden. Die vier 1987 an HM gefundenen Stücke (auch ein ♀), die mit großer Wahrscheinlichkeit aus dem Ruderal (150-300 m entfernt) stammen, zeigen, daß die Bewältigung solcher Distanzen für beide Geschlechter kein besonderes Problem darstellt. Auch die beiden im Garten nachgewiesenen Exemplare sind aus mindestens 200 m Entfernung zugeflogen.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Cirrhia gilvago (1 Individuum)

Distanzen: vermutlich 2
Larvalökologie: die Jungraupen sind auf Ulmen angewiesen, seltener akzeptieren sie auch Pappelkätzchen. In unmittelbarer Nähe beider bisheriger Fundorte wachsen Ulmen.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Cirrhia ocellaris

Distanzen: vermutlich 2
Larvalökologie: anfangs sind die Raupen auf verschiedene Pappelarten angewiesen, welche in unmittelbarer Nähe (20 m) des Fundortes vorkommen.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Cirrhia citrago

11 Individuen 9,1 % ♀- Rate

11 markiert kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein
Distanzen: 2-3
Larvalökologie: monophag an Linde (*Tilia*); das HM-Stück (♂) 1986 stammt also aus dem Waldgürtel und ist mindestens 1 km weit geflogen. Dies stellt vielleicht schon die Obergrenze der Reichweite dieser Art dar, die Verteilung der restlichen Fundorte läßt jedenfalls eine relativ starke Habitatbindung erkennen.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

MELICLEPTRIINAE

Chloridea viriplaca (2 Individuen)

Distanzen: 4
Populationsbiologie: bivoltin
Verbreitungsstrategie: r-Stratege, 1. Gruppe

Chloridea peltigera (2 Individuen)

Distanzen: 4
Populationsbiologie: bivoltin (Einflug und Nachfolgegeneration)
Verbreitungsstrategie: r-Stratege, 1. Gruppe

Pyrrhia umbra (7 Individuen)

Distanzen: vermutlich 2-3
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Panemeria tenebrata (tags 1 Individuum)

Distanzen: 1-2
Larvalökologie: an Hornkraut (*Cerastium*) und Sternmiere (*Stellaria*) gebunden. Sowohl an SiM als auch 1989 im Mallertshofer Holz wurden die tagaktiven Imagines in unmittelbarer Nähe der Raupenfutterpflanzen beobachtet. Selbst bei Störung entfernten sie sich höchstens 10-30 m und kehrten teilweise wieder zurück.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Axylia putris

243 Individuen 21,6 % ♀-Rate

125 markiert 5 Wiederfänge

Tab. 90: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Axylia putris.*

1988	Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	SlN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	3	14	43	6	42	4	3	14	6	3	138
Σ zus.	-	8	-	-	-	-	-	-	-	-	8
♂♂	3	10	28	5	31	4	2	8	5	2	98
♀♀	-	5	9	-	8	-	1	4	-	1	28
Mark.	3	15	36	5	39	4	3	12	5	3	125
W.f.	-	2	2	-	1	-	-	-	-	-	5

Wiederfang-Quote: vergleichsweise hoch; im Garten 1988 konnte bei täglichem Fang ein ♂ nach 1 Tag (kein Hinweis auf Ortstreue) wiedergefangen werden, ein anderes allerdings nach 8 Tagen. Im Wasserwerk ergab sich eine Wiederfang-Quote von 3,8 % bei einer mittleren Verweildauer, die sich mit 4,0 Tagen auf hohem Niveau befindet. Eines der 3 dort wiedergefangenen Stücke war ein ♀, das den Standort wechselte (50 m Distanz).
Distanzen: 2 (-3?)
Populationsbiologie: leicht proterandrisch
Verbreitungsstrategie: intermediärer Typ, 4. Gruppe

BRYOPHILINAE

Euthales algae (25 Individuen)

Distanzen: 3 (-4?)
Larvalökologie: auf Laubholzflechten spezialisiert, nach KOCH (1984) vorwiegend an alten Stämmen. Die beiden nach HM zugeflogenen Stücke stammen also vermutlich aus den umliegenden Wäldern (Flugdistanz mindestens 1 km). Am Würmkanal scheint eine größere Population zu existieren, die 150 m Mindestdistanz nach HW wurde von 10 Individuen bewältigt, obwohl kein Sichtkontakt zur Lichtquelle bestand.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe. OSTHELDER kennt von dieser Art nur einen Einzelfund aus der Nähe von Innsbruck (>100 km); Südbayerische Funde wurden später von WOLFSBERGER (1945-1949; 1953/1954) veröffentlicht. Berücksichtigt man die relativ gute Durchforschung Südbayerns am Anfang dieses Jahrhunderts, insbesondere des Untersuchungsgebietes, so läßt dies die Vermutung zu, daß diese Art Arealausweitungen in großem Stil durchführte.

Bryoleuca raptricula

Distanzen: vermutlich 2-3
Larvalökologie: die Raupe ist an Steinflechten, Schildflechten und Algen zu finden.
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe; um die Jahrhundertwende bis ca. 1925 wurde diese Art interessanterweise in Südbayern nicht nachgewiesen. Eine Häufigkeitszunahme dieser Art, sicherlich verbunden mit Arealausweitungen, erwähnt WOLFSBERGER (1945-1949; 1950; 1953/1954; 1958 und 1960). Nach LATTIN (1967) gehört *B. raptricula* tatsächlich zu den Arealerweiterern.

APATELINAE

Panthea coenobita (1 Individuum)

Distanzen: vermutlich 2
Larvalökologie: an Nadelbäume, vor allem Fichte gebunden. Bisher konnten keine biotopfremden Tiere festgestellt werden.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe; nach LATTIN (1967) erweiterte *P. coenobita* in diesem Jahrhundert ihr Areal.

Daseochaeta alpium (1 Individuum)

Distanzen: vermutlich 2
Larvalökologie: die Raupe frißt an verschiedenen Laubbäumen. Biotopfremde Tiere konnten bisher nicht festgestellt werden. Die Tatsache, daß die Puppe (nach KOCH, 1984) gelegentlich mehrmals überwintert, verringert die potentielle Wachstumsrate der Populationen dieser Art.
Verbreitungsstrategie: vermutlich K-Stratege, 5. Gruppe

Colocasia coryli

43 Individuen 0 % ♀-Rate

25 markiert kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu gering; im Wasserwerk wurden 1988 im Versuch der verringerten Fallendistanzen 17 ♂♂ markiert.
Distanzen: 2
Larvalökologie: an Laubgehölzen. Die Biotopbindung dieser Art scheint relativ stark zu sein. Biotopfremde Tiere, z.B. an HM, konnten bisher noch nicht beobachtet werden.
Populationsbiologie: im Untersuchungsgebiet mit einer mehr oder weniger starken 2. Generation
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Subacronicta megacephala (16 Individuen)

Distanzen: 2
Larvalökologie: als Futterpflanzen dienen Pappel, Espe und Weide; die vier im Garten festgestellten Stücken stammen daher aus mindestens 200 m Entfernung. Durch das von KOCH (1984) erwähnte bisweilen stattfindende Überliegen der Puppen kommt es zu einer Verminderung der potentiellen Populations-Wachstumsrate ("PGR").
Populationsbiologie: bivoltin, die 2. Generation jedoch unvollständig
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Acronicta aceris (18 Individuen)

Distanzen: 2
Larvalökologie: die Raupe lebt an verschiedenen Laubbäumen, biotopfremde Tiere wurden bisher nicht registriert. Bezüglich der Puppenentwicklung gilt das zur vorigen Art Gesagte.
Populationsbiologie: im Gebiet mit einer unvollständigen 2 Generation
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Acronicta leporina (16 Individuen)

Distanzen: 2
Larvalökologie: die Raupe ist auf Laubbäumen, im Untersuchungsgebiet vor allem auf Birke zu finden. Biotopfremde Stücke waren bisher nicht zu beobachten.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Apatele alni (1 Individuum)

Distanzen: 2
Larvalökologie: die Raupen akzeptieren als Futter oligophag einige Laubbaumarten, biotopfremde Tiere traten bisher nicht auf.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Apatele psi (17 Individuen)

Distanzen: 2
Larvalökologie: an Laubbäumen, jedoch etwas mehr polyphag als *A. alni*. Das ♂ am S-Bahnhof mußte mindestens 100 m geflogen sein, sonst konnten bisher keine biotopfremden Tiere festgestellt werden.
Populationsbiologie: abgesehen von den beiden August-Tieren univoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Hyboma strigosa (13 Individuen)

Distanzen: 1-2
Larvalökologie: die Raupe ernährt sich oligophag von einigen Laubhölzern bzw. -gebüschen, biotopfremde Stücke traten bisher nicht auf. *H. strigosa* scheint stark habitatgebunden zu sein, was eine Erklärung für das eher lokale Vorkommen in Südbayern sein könnte.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Pharetra auricoma (31 Individuen)

Distanzen: 2-3
Larvalökologie: recht polyphag, im Untersuchungsgebiet jedoch vor allem an Weide; die an HM anfliegenden Stücke stammen daher wohl aus dem Ruderal (150-300 m entfernt).
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Pharetra rumicis (33 Individuen)

Distanzen: 3 (-4?)
Larvalökologie: relativ polyphag, die HM-Stücke stammen vermutlich aus dem Ruderal (150-300 m).
Populationsbiologie: bivoltin
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Craniophora ligustri

112 Individuen 6,9 % ♀-Rate

102 markiert 1 Wiederfang

Tab. 91: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Craniophora ligustri.*

1987	SIEDLUNG				WALD		HALBTROK-KENRASEN			"DACH. MOOS"	Σ
			Garten								
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	-	3	5	2	11	8	8	1	-	2	40
Σ zus.	-	-	1	1	-	-	6	-	1	-	9
♂♂	-	3	4	1	11	5	14	1	-	1	40
♀♀	-	-	2	1	-	2	-	-	-	-	5
Mark.	-	3	6	2	11	7	14	1	-	1	45
W.f.	-	-	-	-	-	-	1	-	-	-	1

1988	WALD					HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	Garten		Wasserwerk								
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	4	7	14	12	3	7	-	1	5	-	53
Σ zus.	-	10	-	-	-	-	-	-	-	-	10
♂♂	4	16	12	10	3	7	-	1	2	-	55
♀♀	-	-	2	-	-	-	-	-	-	-	2
Mark.	4	16	14	10	3	7	-	1	2	-	57
W.f.	-	-	-	-	-	-	-	-	-	-	-

Wiederfang-Quote: niedrig, vor allem 1988 im Garten (WaS) beim täglich durchgeführten Fang.
Distanzen: 3
Larvalökologie: die Raupe ernährt sich von Esche (*Fraxinus excelsior*), Liguster (*Ligustrum vulgare*) und Flieder. Das 1987 an HM festgestellte ♂ war also mindestens 1 km weit vom Flughafenrand herbeigeflogen.
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

JASPIDIINAE

Jaspidia deceptoria (22 Individuen + tagaktive Exemplare)

Distanzen: 2
Larvalökologie: nach KOCH (1984) an Wiesengräsern, gern an Lieschgras (*Phleum pratense*); die Art ist im Untersuchungsgebiet mehr an trockene Wiesen gebunden und wurde außerhalb des Flughafens und des Wasserwerks nur einmal am Würmkanal gefangen (Au). Die Distanz von 1 km bzw. 1,3 km, die einem Zuflug in den Garten entspräche, liegt offenbar außerhalb des Bereichs der normalen Dispersionsaktivität.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; nach LATTIN (1967) unternahm *J. deceptoria* in diesem Jahrhundert Arealausweitungen.

Jaspidia pygarga (2025 Individuen + tagaktive Exemplare)

Distanzen: 2; das Häufigkeitverhältnis SiN/WaS betrug 1988 in den parallel durchgeführten Fängen 22:67. Dieser Gradient läßt Barrieren gegen die freie Beweglichkeit dieser Art vermuten; im vorliegenden Fall könnte dies der größere Offenlandcharakter an SiN sein.
Larvalökologie: obwohl sich die Raupe von verschiedenen Gräsern ernährt, ist der Falter relativ stark an Gebüsch- bzw. Baumstrukturen gebunden. Die 5 an HM festgestellten Exemplare stammen vermutlich aus dem Ruderal (150-300 m).
Populationsbiologie: je nach Beschaffenheit des Biotops kommt es anscheinend zur Einregulierung einer spezifischen maximalen Populationsdichte. Jahrweise konstant bewirkte diese im Wasserwerk ein Fangergebnis von 50 Individuen, an HO 15 Individuen und im Garten (WaS) 5 Individuen, jeweils bezogen auf eine durchschnittliche Fangnacht in der Hauptflugzeit. In allen Fällen waren diese Werte recht konstant, stärkere Nacht-zu-Nacht-Fluktuationen, wie sie für einige hochmobile Arten typisch sind, traten nicht auf.
Verbreitungsstrategie: K-Stratege, 4. Gruppe

Eustrotia uncula

Distanzen: vermutlich 2
Larvalökologie: auf Seggen (*Carex*) und Zypergras (*Cyperus*) spezialisiert. Am 31.7.83 flogen im Garten bei heißem, windstillem Wetter 2 Exemplare dieses eigentlich typischen Moorbewohners zu. Die minimale Flugdistanz (zum nächstgelegenen Futterpflanzen-Vorkommen) beträgt ca. 300 m, ein Moor bzw. ein naturnahes Feuchtgebiet ähnlicher Prägung existierte zu diesem Zeitpunkt jedoch in einem Radius von mindestens 3 km nicht.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Eustrotia olivana (27 Individuen + tagaktive Exemplare)

Distanzen: 2 (-3?)
Larvalökologie: die Raupe lebt an verschiedenen Gräsern, im Untersuchungsgebiet vor allem an Riedgräsern (*Carex*) und an Land-Reitgras (*Calamagrostis epigejos*). Das SiS-Stück stammt wohl aus dem Flughafengebiet und hatte mindestens 300 m zurückgelegt. Die beiden im Garten festgestellten Stücke sind wohl ebenfalls einer Population außerhalb des Siedlungsgebietes zuzuschreiben und dürften mindestens 500 m, vielleicht sogar 1 km vom Flughafen her zugeflogen sein.
Populationsbiologie: die tagsüber durchgeführten Beobachtungen dieser Art, die vor allem im Flughafen-Ruderal und an der Regattastrecke überaus große Populationsdichten erreicht, lassen auf ähnliche Verhältnisse schließen, wie sie bei J. pygarga bereits erläutert wurden. Aufgescheuchte Individuen flogen ca. 3-10 m weit und setzten sich dann wieder. Das Zurücklegen von größeren Distanzen wurde tagsüber nicht beobachtet.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; nach LATTIN (1967) unternahm *E. olivana* in diesem Jahrhundert Arealausweitungen.

NYCTEOLINAE

Nycteola revayana (6 Individuen)

Distanzen: vermutlich 2
Larvalökologie: monophag an Eiche; an allen bisherigen Fundorten befinden sich in unmittelbarer Nähe Eichen.
Populationsbiologie: bivoltin
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe; die sehr ähnliche *N. asiatica* KRUL. ist jedoch als hochmobile Art, die große Distanzen bewältigen kann, bekannt (siehe REZBANYAI-RESER,1988 und EITSCHBERGER & STEINIGER, 1980).

BENINAE

Earias chlorana (9 Individuen)

Distanzen: 2
Larvalökologie: auf Weide (*Salix*) spezialisiert, bisher konnten keine biotopfremden Tiere festgestellt werden. Die Raupen verursachen nach KOCH (1984) "gelegentlich Kahlfraß in Weidenkulturen".
Populationsbiologie: im Untersuchungsgebiet im Gegensatz zu den Angaben in KOCH (l.c.) univoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe; in anderen Gegenden, wo die Art bivoltin auftritt, können durch die so erhöhte potentielle Wachstumsrate gelegentlich stärkere Vermehrungen stattfinden; unter Umständen ist dies an solchen Standorten mit einer veränderten Strategie verbunden; es könnte sich dann um r-Strategen handeln.

Bena prasinana (77 individuen)

Distanzen: 2
Larvalökologie: die Raupe lebt an einer Reihe von Laubbäumen, vor allem an Rot-Buche (*Fagus sylvatica*). Biotopfremde Tiere, z.B. an HM konnten bisher noch nicht festgestellt werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Pseudoips bicolorana (1 Individuum)

Distanzen: 1-2
Larvalökologie: monophag an Eiche, bisher keine biotopfremden Stücke
Verbreitungsstrategie: K-Stratege, 6. Gruppe

PLUSIINAE

Chrysaspidia putnami

Distanzen: vermutlich 2-3
Larvalökologie: oligophag an eine Reihe hygrophiler Pflanzen gebunden, die in ca. 50 m Entfernung vom Fundort vorkommen.
Populationsbiologie: bivoltin
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Autographa gamma

885* Individuen 4,9 % ♀-Rate

642 markiert 2 Wiederfänge

* dazu tagaktiv zahlreiche weitere Exemplare

Tab. 92: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Autographa gamma.*

1987	SIEDLUNG		WALD Garten		WALD		HALBTROKKENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	7	29	50	53	21	66	66	57	122	2	475
Σ zus.	-	7	81	28	-	8	3	13	5	26	171
♂♂	5	28	90	52	20	56	63	61	80	1	456
♀♀	-	3	6	4	-	6	1	2	2	-	26
Mark.	5	31	96	65	20	62	63	64	81	1	478
W.f.	-	-	-	-	-	-	-	-	-	-	-

1988	WALD Garten		WALD Wasserwerk			HALBTROKKENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	30	34	28	6	23	17	12	47	1	11	209
Σ zus.	-	30	-	-	-	-	-	-	-	-	30
♂♂	14	37	20	5	21	16	12	33	1	-	159
♀♀	1	2	-	-	-	-	-	3	-	-	6
Mark.	15	39	20	5	20	16	12	36	1	-	164
W.f.	-	1	-	-	1	-	-	-	-	-	2

Wiederfang-Quote: sehr niedrig! 1988 wurde im Garten (WaS) bei täglichem Fang nur 1 ♂ (=2,6 %) durch die Lichtwirkung "gefangengehalten". Der einzige unter "regulären" Bedingungen erfolgte Rückfang ereignete sich bei einem an WaN markierten ♂, das 2 Tage später an WNo (50 m) wiedergefangen wurde. Auch die sehr kurze mittlere Verweildauer zeigt also, daß *A. gamma*, die in einer Art "Nullprobe" als bekannter Wanderfalter markiert wurde, erwartungsgemäß reagiert und die Brauchbarkeit der Methode unterstreicht. BETTMANN (1985 a; 1986) erhielt von *A. gamma* mehr Wiederfänge zurück, was wohl methodisch zu begründen ist (täglicher Fang).
Distanzen: 4
Populationsbiologie: bivoltin; im Untersuchungsgebiet fällt die niedrige ♀-Rate auf. MALICKY (1974 a) hatte in Österreich Werte von nahe 50 %, NOWAK (1974) von 29 % beobachtet.
Verbreitungsstrategie: r-Stratege, 1. Gruppe; auch die heimischen Populationen sind hochmobil. Starke Wanderbewegungen (zielgerichteter, rascher Flug) wurden tagsüber und in der Dämmerung vor allem im Moos entlang der Entwässerungsgräben und entlang des Birket-Randes registriert. Die nächtliche Flugaktivität ist jedoch nicht immer mit den Flugmaxima der anderen typischen migranten Arten ("Wanderfalternächte") korreliert.

Autographa pulchrina (3 Individuen)

Distanzen: vermutlich 3
Verbreitungsstrategie: vermutlich intermediärer Typ, 3. Gruppe

Autographa bractea (3 Individuen)

Distanzen: 3-4
Verbreitungsstrategie: intermediärer Typ, 1. Gruppe; *A. bractea* ist eine als Wanderfalter bekannte Art, die hauptsächlich alpin verbreitet ist. Von diesem Verbreitungszentrum aus unternimmt sie Vorstöße über größere Distanzen hinweg. An geeigneten Standorten, z.B. im Berglwald bei Oberschleißheim, wird *A. bractea* jedoch zumindest zeitweilig bodenständig. EITSCHBERGER & STEINIGER (1980) bezeichnen sie als Arealerweiterer.

Macdunnoughia confusa (12 Individuen)

Distanzen: 4
Populationsbiologie: bivoltin
Verbreitungsstrategie: r-Stratege, 1. Gruppe; die starken Häufigkeitsschwankungen von Jahr zu Jahr sowie von Generation zu Generation sind ein weiterer Hinweis auf die hohe Mobilität dieser Art.

Plusia chrysitis (58 Individuen)

Distanzen: 3-4
Populationsbiologie: bivoltin, Flugzeit etwas später als *P. tutti* (vergleiche REICHHOLF, 1985).
Verbreitungsstrategie: r-Stratege, 2. Gruppe

Plusia tutti (42 Individuen)

Distanzen: 3-4
Populationsbiologie: bivoltin, Flugzeit etwas früher als *P. chrysitis* (vergleiche REICHHOLF, 1985).
Verbreitungsstrategie: r-Stratege, 2. Gruppe

Plusia chryson

Distanzen: vermutlich 2-4
Larvalökologie: die Raupe lebt an Wasserdost (*Eupatorium cannabinum*) und Kleb-Salbei (*Salvia glutinosa*). Die Mindest-Flugdistanz vom nächstgelegenen Standort der Futterpflanzen zum Fundort beträgt ca. 300 m. KOCH erwähnt, daß die Art als seltener Irrgast in Gebiete zufliegen kann, die keine eigene Populationen besitzen, also über viele Kilometer hinweg.
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Polychrysia moneta

Distanzen: 2-4
Larvalökologie: die Raupe ist auf Eisenhut- (*Aconitum*) und Ritterspornarten (*Delphinium*) sowie auf Trollblume (*Trollius europaeus*) zu finden. Eine nicht unerhebliche Rolle für die Verbreitungsstrategie dieser Art dürften daher Gärten spielen. Im Garten des Verfassers standen diese Pflanzen zur Verfügung. Die drei (in drei verschiedenen Jahren beobachteten) Exemplare wurden also in ihrem typischen Habitat gefunden.
Populationsbiologie: bivoltin, die 2. Generation ist oft unvollständig und konnte im Untersuchungsgebiet noch nicht nachgewiesen werden.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; die Art unternahm im Lauf dieses Jahrhunderts Arealausweitungen in den Nordwesten Mitteleuropas hinein, wobei z.T. größere Distanzen bewältigt werden mußten (KOCH, 1984; LATTIN, 1967).

Chrysoptera c-aureum (3 Individuen)

Distanzen: 2 (-3?)
Larvalökologie: die Raupe ist auf Wiesenrautearten (*Thalictrum*) und Akelei (*Aquilegia*) spezialisiert. Im Untersuchungsgebiet werden offensichtlich auch die im Garten angepflanzten Akeleisorten angenommen, wie die regelmäßigen Funde der letzten 3 Jahre vermuten lassen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; *C. c-aureum* wurde somit im Münchener Norden erstmals außerhalb der Isarauen nachgewiesen; ein solcher Kolonisationsvorgang hätte im Lauf dieses Jahrhunderts über eine Mindestdistanz von 7 Kilometer erfolgen müssen.

Abrostola triplasia (12 Individuen)

Distanzen: 2 (-3?)
Larvalökologie: monophag an der Großen Brennessel (*Urtica dioica*); diese war in der unmittelbaren Nähe aller bisherigen Fundorte zu finden.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Abrostola asclepiadis (12 Individuen)

Distanzen: 2
Larvalökologie: monophag am Schwalbenwurz (*Cynanchum vincetoxicum*), welcher im Berglwald und im Schweitzerholz an vielen Stellen recht häufig ist. Die im Garten gefundenen Stücke (nur ♂♂) stammen also mindestens vom Berglwaldrand (200 m), das WaN-♂ mußte auch zumindest 150-200 m von der nächstgelegenen Raupenfutterpflanze her geflogen sein.
Populationsbiologie: im Gegensatz zu den beiden anderen im Gebiet nachgewiesenen Arten der Gattung univoltin
Verbreitungsstrategie: K-Stratege, 5. Gruppe; entsprechend der zerstreuten Verbreitung der Raupenfutterpflanze scheint es sich *A. asclepiadis* nur in Jahren mit guter Bestandsentwicklung (z.B. 1987 und 1988) erlauben zu können, Vorstöße über biotopfremdes Gebiet durchzuführen.

Abrostola trigemina (12 Individuen)

Distanzen: 2 (-3?)
Larvalökologie: monophag an der Großen Brennessel; das HM-Exemplar stammt also zumindest aus dem Ruderal (150-300 m). Der Häufigkeitsgradient im Wasserwerk könnte auf Barrieren gegen die freie Mobilität hinweisen.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

CATOCALINAE

Astiodes sponsa (1 Indviduum)

Distanzen: 2–4, aber relativ biotoptreu
Larvalökologie: monophag an Eiche, welche sich auch in unmittelbarer Nähe des Fundortes befand
Verbreitungsstrategie: intermediärer Typ, 1. Gruppe; *A. sponsa* ist als Wanderfalter bekannt, dürfte im Untersuchungsgebiet in den älteren Eichenbeständen jedoch bodenständige Populationen besitzen.

Catocala nupta (4 Individuen)

Distanzen: 2–3
Larvalökologie: an Weiden und Pappeln; das an HM gefangene ♂ ist vermutlich aus dem Ruderal bei einer Distanz von 150–300 m zugeflogen. Aus ähnlichen Mindestentfernungen stammen die regelmäßig im Garten festgestellten Stücke.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Callistege mi

Diese tagfliegende Art wurde in der Auswertung unberücksichtigt gelassen, da sie mit Lichtfallenfängen nicht erfaßbar ist. *C. mi* ist im Untersuchungsgebiet offensichtlich univoltin, sie ist wohl als intermediärer Typ der 5. Gruppe einzustufen.

Ectypa glyphica

Wie *Callistege mi*, es wurde lediglich 1 Exemplar der 2. Generation beobachtet. Interessant ist wie bei der vorhergehenden Art der bisher fehlende Nachweis im Garten.

OPHIDERINAE

Scoliopteryx libatrix (15 Individuen)

Distanzen: 2–3
Larvalökologie: die Raupe ernährt sich von Weide und Pappel; das HM-Stück ist also als Zuflieger aus einer Distanz von mindestens 150–300 m (Ruderal) zu werten. Auch die vergleichsweise oft im Garten zu beobachtenden Stücke (auch ♀♀) mußten 200–300 m vom nächstgelegenen Standort der Futterpflanzen (einzelstehende Weiden) geflogen sein.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Lygephila pastinum (38 Individuen)

Distanzen: 2; der starke Häufigkeitsgradient im Wasserwerk spricht für Barrieren gegen die freie Beweglichkeit dieser Art.
Larvalökologie: an verschiedenen Schmetterlingsblütlern; im Ort, wo die Vertreter dieser Pflanzenfamilie nur sehr spärlich auftreten, wurden von *L. pastinum* daher nur vereinzelt (zugeflogene) Exemplare registriert.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Parascotia fuliginaria (5 Individuen)

Distanzen: 1–2
Larvalökologie: es handelt sich um eine relativ stenöke Art, deren Raupen von Holzpilzen, Flechten und Algen leben. Das am S-Bahnhof gefundene ♂ mußte mindestens 200 m vom nächsten möglichen Ort der Larvalentwicklung her geflogen sein.
Populationsbiologie: im Garten (WaS) fällt das regelmäßige Auftreten (♂♂ + ♀♀) bei sehr geringen Häufigkeitsschwankungen auf. Es handelt sich vermutlich um eine kleine Population im Gleichgewichtszustand. Ein solches Gleichgewicht auf niedrigem Niveau dürfte für die in Südbayern nur lokal und selten anzutreffende *P. fuliginaria* typisch sein. Schon 30 m entfernt (SiN) konnte bisher kein Stück nachgewiesen werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Phytometra viridaria (3 Individuen + tagaktive Exemplare)

Distanzen: 3; tagsüber wurden Exemplare bei Flügen von mehreren 100 m beobachtet.
Larvalökologie: die Raupe lebt an Kreuzblümchen (*Polygala*).
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Rivula sericealis (219 Individuen)

Distanzen: 2
Larvalökologie: die Raupe ernährt sich von Gräsern; in den Wäldern ist diese Art bisweilen recht häufig, im Offenland (HM) war *R. sericealis* jedoch bisher nicht zu beobachten, was auf einen Aktionsradius von unter 1 km hinweist.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; die starken Häufigkeitsschwankungen im Garten von Jahr zu Jahr könnten als Indiz dafür gewertet werden, daß *R. sericealis* hier verstärkt als zufliegender Gast auftritt.

HYPENINAE

Laspeyria flexula

269 Individuen 15,9 % ♀- Rate
43 markiert kein Wiederfang

Wiederfang-Quote: niedrig
Distanzen: 2-3
Larvalökologie: die Raupe ist auf Rindenflechten und -algen vor allem von älteren Baumbeständen spezialisiert. Dementsprechend sind die beiden an HM registrierten ♂♂ als Gastarten zu charakterisieren, die vermutlich vom Flughafenrand (Distanz: 1 km) stammen. Eines flog bei ruhigem windstillen Wetter, das andere bei leichtem Westwind an. Der starke Häufigkeitsgradient HO/HM 1986 verdeutlicht jedoch, daß diese Distanz wohl schon die Obergrenze der normalen Dispersionsaktivität von *L. flexula* darstellt.
Verbreitungsstrategie: intermediärer Typ,, 5. Gruppe

Colobochyla salicalis (1 Individuum + einige tagaktive Exemplare)

Distanzen: 1-2
Larvalökologie: die Raupen sind nach KOCH (1984) auf die zartesten Triebe von Weide und Pappel spezialisiert. Bisher konnten keine biotopfremden Tiere nachgewiesen werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; *C. salicalis* tritt nicht nur im Untersuchungsgebiet sondern auch in Südbayern allgemein nur lokal und einzeln auf.

Herminia barbalis (2 Individuen)

Distanzen: 2
Larvalökologie: die Larvalentwicklung spielt sich an Laubhölzern ab; im Offenland wurde die Art bisher noch nie, an etwas offener strukturierten Standorten (SiM, WaN, HW, Mo/1985) insgesamt nur in 2 Exemplaren beobachtet. Entfernungen über 500 m über biotopfremdes Gebiet scheinen eine Barriere gegen die Verbreitung darzustellen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Zanclognatha tasipennalis (74 Individuen)

Distanzen: 2-3
Larvalökologie: die Raupen sind nach KOCH (1984) auf "herabgefallene, faule und modernde Blätter von Gräsern, niedrigen Pflanzen und Laubgehölzen" spezialisiert. Dies stellt eine interessante Einnischung dar, die *Z. tarsipennalis* auch von der folgenden sehr ähnlichen Art, *Z. tarsicrinalis* unterscheidet. *Z. tarsipennalis* ist im Untersuchungsgebiet recht stenök an die Ränder und Gebüschzonen der etwas trockeneren Wälder gebunden. Das ♂ an HM ist jedoch nicht zwingend als biotopfremd zu charakterisieren. Im Moos konnte bisher kein Exemplar nachgewiesen werden. Die Distanz von ca. 3 km, die zu einem Zuflug nötig wäre, liegt außerhalb der normalen Dispersionsaktivität dieser Art.
Populationsbiologie: im Untersuchungsgebiet bivoltin, die 2. Generation ist jedoch unvollständig.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; OSTHELDER (1925-1933) erwähnt für das südbayerische Faunengebiet nur Beuerberg und Herrsching als Fundort. Ob dies lediglich an Bestimmungschwierigkeiten lag, oder ob tatsächlich eine Arealausweitung über größere Distanzen stattgefunden hat, muß hier noch offenbleiben.

Zanclognatha tarsicrinalis (236 Individuen)

Distanzen: 2
Larvalökologie: im Gegensatz zur vorigen Art ernähren sich die Raupen von herabgefallenen, trockenen Blättern von Himbeere, Brombeere und Waldrebe (*Clematis vitalba*). *Z. tarsicrinalis* ist im Untersuchungsgebiet stenök an etwas feuchtere Wälder und deren Ränder gebunden. Im Offenland (HM) konnte die Art bisher noch nicht nachgewiesen werden.
Populationsbiologie: im Gegensatz zu *Z. tarsipennalis* im Untersuchungsgebiet offensichtlich univoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Zanclognatha grisealis (19 Individuen)

Distanzen: 2
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Trisateles emortualis (32 Individuen)

Distanzen: 2
Larvalökologie: oligophag an einigen Laubbäumen, vor allem an deren abgefallenen Blättern. Die Art scheint sehr biotoptreu zu sein: An den Stellen des Vorkommens befinden sich in unmittelbarer Nähe Eichen oder Buchen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Hypena obsealis

Distanzen: vermutlich 2
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Hypena proboscidalis

171* Individuen	19,7 % ♀- Rate
61 markiert	2 Wiederfänge

* dazu viele tagaktive Exemplare

Wiederfang-Quote: sehr niedrig! Im Garten (WaS) wurden 1988 bei täglichem Fang 21 markierte Tiere freigelassen, von denen nur 2 ♂♂ (9,5 %) nach jeweils 1 Tag wiedergefangen wurden. Im Wiederfangergebnis fehlen also Hinweise auf Ortstreue.
Distanzen: 3
Larvalökologie: die 5 an HM festgestellten Exemplare (auch ein ♀) stammen, nach den in KOCH (1984) genannten Raupenfutterpflanzen beurteilt, zumindest aus dem Ruderal (150-300 m), derartige Distanzen liegen im Bereich der normalen Dispersionsaktivität.
Populationsbiologie: im Untersuchungsgebiet bivoltin; proterandrisch
Verbreitungsstrategie: r-Stratege, 2. Gruppe; in der 2. Generation war die Flugaktivität mit der der typischen Wanderfalter in den Wanderfalternächten korreliert. *Hypena proboscidalis* ist die mobilste der im Untersuchungsgebiet festgestellten Hypeninen, ihre Strategie erinnert an die einiger typischer r-Strategen unter den Tagfaltern, deren Larvalentwicklung ebenfalls hauptsächlich an Brennessel abläuft, als Beispiele mögen hier das Landkärtchen (*Araschnia levana*) oder der Kleine Fuchs (*Aglais urticae*) genügen.

GEOMETRIDAE

ARCHIEARINAE

Archiearis parthenias

Da diese tagaktive Art in Lichtfallenfängen nicht zu erfassen ist, wurde sie bei den Auswertungen ausgeklammert. Es handelt sich um einen monophagen Birkenbewohner (nur selten wird Rot-Buche akzeptiert), der vermutlich als K-Stratege der 6. Gruppe zu charakterisieren ist. Innerhalb des Birkets wurde *A. parthenias* jedoch bei Flügen bis zu 300 m Distanz beobachtet (von Baumwipfel zu Baumwipfel).

OENOCHROMINAE

Alsophila aescularia

148 Individuen 0 %* ♀-Rate

129 markiert 10 Wiederfänge

* die ♀♀ sind flugunfähig, an WaS wurde 1987 ein ♀ an einem Baumstamm sitzend gefunden.

Tab. 93: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Alsophila aescularia.*

1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	2	-	18	1	-	1	2	-	-	-	24
Σ zus.	-	4	30	11	-	5	7	-	10	-	65
Mark.	2	4	43	3	-	6	8	-	10	-	76
W.f.	-	-	9	1	-	-	-	-	-	-	10

1988	WALD Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"	
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We
Σ par.	8	7	7	-	2	2	-	1	29	1
Σ zus.	-	2	-	-	-	-	-	-	-	-
Mark.	8	7	7	-	2	2	-	1	25	1
W.f.	-	-	-	-	-	-	-	-	-	-

Wiederfang-Quote: niedrig! Mit einer Ausnahme erfolgten die Wiederfänge 1987 im Garten bei täglichem Betrieb der Lichtfalle und sind auf eine "Gefangenschaft" im Bann der Lichtquelle zurückzuführen! Die mittlere Verweildauer betrug hierbei niedrige 1,5 Tage bei einem Maximum von 3 Tagen. Verglichen beispielsweise mit dem ebenfalls in einer extremen Jahreszeit und nur im männlichen Geschlecht fliegenden Frostspanner *Operophthera brumata* sind diese Werte als sehr niedrig einzustufen.
Ein ♂ wechselte den Ort (WaS→SiN = 30 m) in der Zeitspanne von einem Tag.
Distanzen: ♂♂ 2(-3?), ♀♀ 1; im Wasserwerk könnte der Häufigkeitsgradient ein Hinweis darauf sein, daß Barrieren gegen die Mobilität der ♂♂ existieren. Der Standort WNw zeichnet sich dadurch aus, daß hier unter den 3 Wasserwerk-Fangplätzen die Schneeschmelze am spätesten erfolgt. Dies behindert unter Umständen den Schlüpfvorgang von *A. aescularia.*
Larvalökologie: an Laubbäumen und -sträuchern; an HM wurde bisher kein Exemplar festgestellt, die Distanz von 1 km scheint außerhalb der normalen Dispersionsaktivität zu liegen. Im Moos 1989 wurden in Parallelfängen am Waldrand 7 Exemplare, 45 m entfernt davon im Offenland nur noch 2 Exemplare festgestellt.
Verbreitungsstrategie: K-Stratege, 5. Gruppe (was die ♂♂ betrifft); die ♂♂ gewährleisten durch die vergleichsweise hohe Mobilität eine gute Gendurchmischung. Für eine Verbreitung über besonders "flugfähige" Eiraupen wie bei *Orgyia recens* gibt es keine Indizien. Es könnte höchstens eine Verdriftung von sich abseilenden Räupchen eine Rolle spielen. Die erwachsenen Raupen verpuppen sich im Juni an der Basis der Futterpflanze (CARTER & HARGREAVES, 1987). Sie scheiden als Verbreitungsstadium aus. Vielleicht sind auch die mit langen Beinen versehenen ♀♀ in der Lage, die für die Verbreitungsstrategie der Art notwendigen Strecken zurückzulegen oder zumindest die Eier auf eine hohe "Startposition" in den Bäumen zu bringen.
Der Feinddruck durch Singvögel sowie Störungen durch Parasiten spielen bei dieser Art aufgrund der extremen jahreszeitlichen Einnischung eine geringere Rolle als bei den Sommerarten. Das Gleichgewicht einer Population ist dadurch wohl weniger störanfällig. Dies ist eine der Voraussetzungen für eine K-Strategie, denn der Totalausfall einer lokalen Population könnte nur schwer wieder durch kolonisierende Individuen wettgemacht werden.

Odezia atrata

Auch diese tagaktive Art wurde bei der Auswertung ausgeklammert, da sie in Lichtfallenfängen nicht erfaßt wurde. Es handelt sich vermutlich um eine Art intermediären Strategietyps die in die 5. Gruppe einzuordnen ist.

GEOMETRINAE

Geometra papilionaria (22 Individuen)

Distanzen: 2
Larvalökologie: oligophag an einer Reihe von Laubgehölzen; das an HM 1986 festgestellte Stück stammt zumindest aus dem Ruderal (150-300 m).
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Comibaena pustulata

Distanzen: 1-2
Larvalökologie: monophag an Eiche. Die vier 1986 gefangenen Exemplare flogen die an HO postierte Falle an, in deren unmittelbaren Nähe größere Eichenbestände existieren.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Hemithea aestivaria (30 Individuen)

Distanzen: 2; der Häufigkeitsgradient zwischen WaN und WNo auf nur 50 m Strekke weist vielleicht auf Barrieren gegen die Verbreitung hin.
Larvalökologie: die Raupenfutterpflanzen weisen *H. aestivaria* als Art der Wälder und (vor allem) der Waldränder aus. Dementsprechend konnte bisher im Offenland (HM) kein Exemplar nachgewiesen werden. Die normalerweise im Rahmen der Dispersionsaktivität und des trivial movement zurückgelegten Distanzen liegen wohl unter 1 km.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Thalera fimbrialis (16 Individuen)

Distanzen: 2-3
Larvalökologie: die Raupen fressen an einer Reihe von niedrigwachsenden Pflanzen, die *T. fimbrialis* als xerothermophil auszeichnen. Im Flughafengebiet stellt wohl die Gemeine Schafgarbe (*Achillea millefolium*) die Haupt-Nahrungsquelle dar. Das an der Würmau (Au) festgestellte ♂ könnte vom Flughafengebiet her zugeflogen sein (Mindestdistanz 700 m). Die Gemeine Schafgarbe wächst jedoch auch hier vereinzelt. Im Siedlungsgebiet wurde die Art noch nie beobachtet. Die Distanzen von 1 km (Zuflug in den Garten), vielleicht aber auch von 300 und 700 m (→ SiS und SiM), werden über biotopfremdes Gebiet offensichtlich nicht bewältigt.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Hemistola chrysoprasaria (2 Individuen)

Distanzen: vermutlich 2; dies gilt vielleicht nur für das trivial movement von *H. chrysoprasaria*; KOCH (1984) erwähnt ein neuerliches Auftreten in Sachsen, wobei sicherlich größere Distanzen zurückgelegt worden sein müssen.
Larvalökologie: die Raupen dieser Art sind auf Waldrebe (*Clematis vitalba, -viticella*) spezialisiert, welche im Wasserwerk, dem Fundort dieser Art, vorkommt.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe;

Iodis lactearia (16 Individuen + einige dämmerungsaktive Exemplare)

Distanzen: 1-2
Larvalökologie: die Raupenfutterpflanzen charakterisieren diese Art als Bewohner der etwas feuchteren Wälder und deren Ränder. Im Offenland (HM), aber auch an baum/buschbestandenen Standorten mit etwas stärkerem Offenlandcharakter (SiM, WaN, HW, Mo/1985) konnte kein Exemplar nachgewiesen werden. Die Dispersionsaktivitäten von *I. lactearia* über biotopfremdes Gebiet scheinen sich in Bereichen von wenigen 100 m abzuspielen, wenn nicht sogar unter 100 m.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

STERRHINAE

Sterrha serpentata

Distanzen: 1-2; tagsüber wurden Flüge über ca. 50 m beobachtet.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Sterrha muricata (15 Individuen)

Distanzen: 1-2; das im Untersuchungsgebiet wie auch überregional nur lokale Vorkommen ist ein erster Hinweis auf vergleichsweise geringe Mobilität. Distanzen von 1,2 km (Zuflug in den Garten) und 900 m (Zuflug Wasserwerk→WaM und HW→SiS) liegen außerhalb der normalen Dispersionsaktivität.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Sterrha biselata (94 Individuen)

Distanzen: 2; im reinen Offenland (HM) wurde diese vor allem an Waldränder gebundene Art noch nie gefunden. Die im "trivial movement" zurückgelegten Distanzen liegen im Bereich von wenigen 100 m und wohl eher darunter. Ein Kilometer wird so gut wie nie bewältigt.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Sterrha inquinata (1 Individuum)

Distanzen: vermutlich 2
Larvalökologie: die Raupen leben an trockenen Pflanzenresten; *S. inquinata* wird wie die folgende Art vor allem in Sekundärlebensräumen, die vom Menschen geschaffen wurden, angetroffen. Siehe Bemerkungen bei *S. seriata.*
Populationsbiologie: bivoltin
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Sterrha seriata (3 Individuen)

Distanzen: vermutlich 2
Larvalökologie: die Raupe frißt "dürre, verwelkte oder modernde Reste von niedrigen Pflanzen und Laub, Moos und Flechten" (KOCH, 1984). In Mitteleuropa scheinen sekundäre Lebensräume in der Nähe menschlicher Behausungen bevorzugt zu werden. Vielleicht fand *S. seriata* auf diese Weise einen stabileren Lebensraum als das von Natur aus vorprogrammiert war. Beobachtungen des Verfassers in Südeuropa (Süditalien) kennzeichnen die dortigen Populationen dieser Art eher als stark dynamisch, die ubiquitär anzutreffenden Individuen als mobil, und die Strategie im r-K-Kontinuum mehr in Richtung r-Ende verschoben.
Populationsbiologie: bivoltin
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Sterrha dimidiata (41 Individuen)

Distanzen: 2, wie *Sterrha biselata*
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Sterrha emarginata (1 Individuum)

Distanzen: vermutlich 2-3
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Sterrha aversata

252 Individuen   10,9 % ♀- Rate

191 markiert   8 Wiederfänge

Tab. 94: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Sterrha aversata.*

1 • 2 1987	SIEDLUNG		WALD Garten				HALBTROK-KENRASEN			"DACH, MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	1	3	10	9	8	11	10	2	6	6	66
Σ zus.	-	-	1	13	-	1	1	-	3	-	19
♂♂	-	2	6	10	4	8	9	2	6	3	50
♀♀	1	-	2	2	-	-	1	-	-	-	6
Mark.	1	2	8	12	4	8	10	2	6	3	56
W.f.	-	-	-	-	-	-	-	-	-	-	-

1 • 2 1988	WALD Garten		Wasserwerk			HALBTROK-KENRASEN			"DACH, MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	22	37	9	20	14	9	-	7	2	5	125
Σ zus.	-	42	-	-	-	-	-	-	-	-	42
♂♂	20	55	8	15	10	7	-	3	-	4	122
♀♀	-	7	-	4	2	-	-	1	1	-	15
Mark.	19	61	8	19	12	7	-	4	1	4	135
W.f.	3	5	-	-	-	-	-	-	-	-	8

Wiederfang-Quote: in beiden Generationen niedrig! An WaS sind alle 5 Wiederfänge methodisch zu erklären: Beim täglichen Betrieb der Falle wurden die Stücke (♂♂) durch die Lichtwirkung einen Tag lang festgehalten. Längere Fang/Rückfangintervalle waren hier nicht zu beobachten und es ereignete sich auch kein Zweitwiederfang.
Ein ♂ wechselte von einer Nacht zur nächsten den Ort (WaS→SiN) und 2 ♂♂ wurden SiN unter "regulären" Bedingungen (fangfreie Nacht dazwischen) wiedergefangen. Auch hier betrugen die Verweilzeiten jeweils nur 2 Tage.
Distanzen: 2-3; 1988 waren an WaS auch starke Nacht-zu-Nacht-Fluktuationen festzustellen.
Larvalökologie: obwohl *S. aversata* ihre Raupenfutterpflanzen so gut wie überall auffinden könnte, ist diese Art im reinen Offenland (HM) vermutlich nicht bodenständig; sie bevorzugt geschütztere Standorte (Winddeckung, Schutz vor Luftfeinden), wie dies auch die leichten Häufigkeitsgradienten im Wasserwerk und im Garten zeigen. Die beiden also offensichtlich nach HM zugeflogenen ♂♂ (1987) wurden in Nächten mit starkem bzw. leichtem Westwind festgestellt.
Populationsbiologie: bivoltin; die ♀♀ sind an offeneren Standorten unterrepräsentiert, für sie ist zur Gewährleistung der Fortpflanzung offenbar ein stärkeres Schutzverhalten entwickelt als bei den ♂♂.
Die f. *remutata* L. überwiegt im Untersuchungsgebiet 1986-1988 unabhängig von Geschlecht, Standort, Generation und Jahr mit ca. 80 % der Gesamt-Individuenzahl.
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Cyclophora albipunctata (20 Individuen + einige dämmerungsaktive Exemplare)

Distanzen: 1–2
Larvalökologie: die Raupe ist auf Birke spezialisiert und akzeptiert nur selten Eiche oder Erle; biotopfremde Stücke konnten bisher noch nicht nachgewiesen werden. Der Häufigkeitsgradient zwischen WaN und WNo (50 m) könnte ein Indiz dafür sein, daß schon die Distanz von ca. 70 m (=Entfernung von den in der Nähe von WaN stehenden Birken) eine Barriere gegen die Mobilität dieser Art darstellt.
Populationsbiologie: bivoltin
Verbreitungsstrategie: K–Stratege, 6. Gruppe

Cyclophora punctaria

439 Individuen 42,0 % ♀– Rate

307 markiert 23 Wiederfänge

Tab. 95: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Cyclophora punctaria*.

1 - 3 1987	SIEDLUNG		Garten		WALD		HALBTROK-KENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	–	–	1	15	3	2	29	–	3	5	58
Σ zus.	–	–	4	4	–	–	–	–	–	–	8
♂♂	–	–	2	8	2	–	9	–	–	3	24
♀♀	–	–	1	4	1	1	9	–	2	1	19
Mark.	–	–	3	12	3	1	16	–	2	3	40
W.f.	–	–	–	–	–	–	–	–	–	–	–

1 - 3 1988	WALD Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	40	82	20	19	15	64	–	9	7	1	257
Σ zus.	–	116	–	–	–	–	–	–	–	–	116
♂♂	17	89	4	8	4	31	–	4	3	–	160
♀♀	16	56	9	7	7	15	–	2	2	–	114
Mark.	32	143	12	14	11	46	–	4	5	–	267
W.f.	–	22	–	–	–	1	–	–	–	–	23

Wiederfang–Quote: relativ niedrig; der einzige unter "normalen" Bedingungen, d.h. bei dazwischenliegenden fangfreien Nächten wiedergefangene Falter war ein ♂ an HO nach 6 Tagen.
Im Garten ergab sich 1988 bei täglichem Fang folgendes Bild: Sämtliche 19 Erstwiederfänge erfolgten nach einem Intervall von nur 1 Tag! Nur 3 Tiere wurden ein weiteres Mal gefangen, zwei davon wieder nach einem 1-Tages-Intervall, eines, ein Weibchen, nach 3 Tagen, was eine Verweildauer von 4 Tagen ergibt. Die mittlere Verweildauer beträgt demnach sehr niedrige 1,3 Tage.
Die Wiederfangquote 1988 im Garten betrug in der 1. Generation 4/11 = 36,4 %, in der 2. Generation 13,6 %. Vielleicht spielen hierbei unterschiedliche Dispersionsaktivitäten eine Rolle.
Die ♀♀ sind im Wiederfangergebnis mit 2/19 = 10,5 % unterrepräsentiert, sie scheinen jedoch längere Verweilzeiten zu aufzuweisen (s.o.).
Distanzen: 2
Larvalökologie: die Raupe lebt monophag an Eiche und nimmt nur selten Birke an. An HW trat *C. punctaria* in beiden Jahren erst in der 2. Generation auf, hier allerdings nicht selten. Einzelstehende Eichen (2–3 m hoch) befinden sich in ca. 100 m Entfernung. Dies könnte ein Hinweis darauf sein, daß die Falter der 1. Generation recht ortstreu sind, die der 2. Generation in beiden Geschlechtern Distanzen von mindestens 100 m jedoch problemlos bewältigen.
Die Distanz von 1 km über biotopfremdes Gebiet (Zuflug nach HM) liegt in beiden Generationen nicht im Bereich der normalen Dispersionsaktivität.
Populationsbiologie: bivoltin + eine partielle 3. Generation; in beiden Generationen wenig proterandrisch! Während der Flugzeit werden immer wieder Schübe von frischen Faltern festgestellt, die auf eine kontinuierliche Emergenz hindeuten. Vielleicht spielt bei dieser Art die Mortalität eine größere Rolle als bei anderen Arten.
Verbreitungsstrategie: K–Stratege, 5. Gruppe

Cyclophora linearia (4 Individuen)

Distanzen: vermutlich wie *C. punctaria*
Larvalökologie: die Raupe ist vor allem an Rot–Buche, jedoch auch an Eiche, Birke und Heidelbeere zu finden. Bisher konnten keine biotopfremden Tiere festgestellt werden.
Populationsbiologie: im Untersuchungsgebiet bivoltin
Verbreitungsstrategie: vermutlich K–Stratege, 5. Gruppe

Calothysanis griseata (112 Individuen + tagsüber einige weitere Exemplare)

Distanzen: 3
Larvalökologie: an Ampfer– (*Rumex*) und Knötericharten (*Polygonium, Fallopia*) gebunden, die 3 HM–Exemplare 1986 stammen zumindest aus dem Ruderal (150–300 m).
Populationsbiologie: bivoltin
Verbreitungsstrategie: r–Stratege, 3. Gruppe

Scopula immorata (66 Individuen + tagsüber einige weitere Exemplare)

Distanzen: 2; für die Bewältigung der Distanz von 1 km (z.B. ein Zuflug vom Flughafengebiet in den Garten) konnte noch kein Nachweis erbracht werden.
Larvalökologie: im Flughafengebiet dürfte unter den in KOCH (1984) genannten Raupenfutterpflanzen vor allem die Gemeine Schafgarbe (*Achillea millefolium*) in Frage kommen. Die Art ist somit in einer besonderen Weise an die Schafbeweidung angepaßt, da diese Pflanzen von den Schafen stehen gelassen werden.
Populationsbiologie: bivoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Scopula nigropunctata (70 Individuen)

Distanzen: 1-2
Larvalökologie: die Raupenfutterpflanzen charakterisieren *S. nigropunctata* als eine an die Wiesen von Wäldern und Waldrändern gebundene Art. Damit steht der bisher fehlende Nachweis im reinen Offenland (HM) im Einklang. In diesem Sinn sind auch die niedrigen Fangergebnisse an SiM und HW, sowie der Häufigkeitsgradient zwischen WaN und WNo sowie zwischen SiN und WaS auf nur 50 bzw. 30 m Strecke zu beurteilen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Scopula ornata (15 Individuen)

Distanzen: 2, selten 3; das im Garten festgestellte Exemplar ist vermutlich vom Verbreitungszentrum am Flughafen herbeigeflogen (1 km). Diese Distanz stellt jedoch offensichtlich schon die Obergrenze der Dispersionsaktivität dar und wird nicht regelmäßig geflogen; in der Fangnacht ging auch ein Gewitter nieder, dessen böige Winde fluguntersützend gewirkt haben könnten.
Larvalökologie: im Untersuchungsgebiet leben die Raupen dieser Art wohl vor allem an Schafgarbe und Thymian (*Thymus*). Schon in einer Einbuchtung von ca. 30 m in den Wald hinein (HO) war ein deutlicher Häufigkeitsabfall festzustellen.
Populationsbiologie: bivoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Scopula rubiginata (20 Individuen)

Distanzen: 2
Larvalökologie: in einer ähnlichen Weise an trockene Wiesen gebunden wie die vorige Art. Distanzen von 1 km (Zuflug in das Siedlungsgebiet) liegen offensichtlich außerhalb der normalen Dispersionsaktivität und des trivial movement.
Populationsbiologie: bivoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Scopula immutata

Distanzen: vermutlich 2;
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Scopula lactata (5 Individuen)

Distanzen: vermutlich 2-3
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

LARENTIINAE

Scotopteryx chenopodiata

siehe verringerte Fallendistanzen (8.3.)

754 Individuen 44,6 % ♀- Rate

380 markiert 27 Wiederfänge

Tab. 96: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Scotopteryx chenopodiata.*

1987	SIEDLUNG		Garten		WALD		HALBTROKKENRASEN			"DACHMOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	1	-	-	1	12	143	11	1	37	(8)	214
Σ zus.	-	-	1	-	-	-	2	-	-	-	3

1988	Garten		WALD Wasserwerk			HALBTROKKENRASEN			"DACHMOOS"	
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We
Σ par.	2	3	136	116	212	22	-	47	2	-
Σ zus.	-	4	-	-	-	-	-	-	-	-
♂♂	2	6	52	52	84	10	-	14	-	-
♀♀	-	-	55	35	56	6	-	21	-	-
Mark.	-	3	104	84	138	16	-	35	-	-
W.f.	1	1	7	4	8	3	-	3	-	-

Wiederfang-Quote: ist als hoch einzustufen (siehe Wasserwerk). Auch die Wiederfänge am Flughafen deuten auf lange Verweildauern hin: Der Wiederfang erfolgte nach durchschnittlich 4,7 Tagen (3♂♂, 3♀♀).
Distanzen: 1-2; die Strecke vom Ruderal (häufiges Vorkommen von *chenopodiata*) zum HM-Fangplatz (ca. 150-300 m) kann in den meisten Jahren zurückgelegt werden. Im Normalfall werden die 200 m in das Innere des Moorbirkenwäldchens nicht bewältigt; an dessen Rand dagegen war *S. chenopodiata* regelmäßig anzutreffen. Die Siedlungs-Stücke sind vermutlich zugeflogen.
Populationsbiologie: die ♀♀ sind ortsbeständiger und haben längere Verweilzeiten (Wasserwerk, Flughafen). Im Ort flogen 1988 dementsprechend nur ♂♂ zu.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Anaitis praeformata (2 Individuen)

Distanzen: vermutlich 2-3
Larvalökologie: auf Hartheu (*Hypericum*) spezialisiert; im Garten wächst diese Futterpflanze erst seit 1988, die Entwicklung, die sich über den Winter erstreckt, konnte also nicht im Garten abgelaufen sein, das hier nachgewiesene ♂ kam aus mindestens 150 m Entfernung (Berglwaldrand).
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe; es handelt sich um die ersten Nachweise für den Münchner Norden. Für die offensichtlich stattgefundene Kolonisation durch diese mehr montane Art waren Flugleistungen von durchschnittlich mindestens 1 km/Generation die Voraussetzung.

Anaitis efformata

197 Individuen 15,4 % ♀- Rate

26 markiert 3 Wiederfänge

Wiederfang-Quote: in der 1. Generation hoch, in der 2. Generation niedrig, Stichprobe noch zu gering; diese Feststellungen besitzen einen noch recht hypothetischen Charakter, da sie auf einem einzigen mehrfach gefangenen Individuum basieren: An WaS wurde 1988 in der 1. Generation bei täglichem Betrieb der Lichtfalle ein ♂ viermal bei Intervallen von 3, 1 und 4 Tagen gefangen, die Verweildauer betrug also 8 Tage.
In der 2. Generation wurden 15 Individuen markiert und keines rückgefangen.
Distanzen: 3
Larvalökologie: monophag an Tüpfel-Hartheu (*Hypericum perforatum*); an vielen der Fundorte kommt die Raupenfutterpflanze nicht in der näheren Umgebung vor (z.B. Garten und HM). Die Häufigkeit an diesen Stellen ist daher bemerkenswert und deutet auf relativ hohe Dispersionsaktivitäten hin.
Populationsbiologie: bivoltin, mit starken Fluktuationen von Generation zu Generation (die 1. Generation ist meist schwächer), aber auch von Jahr zu Jahr.
Verbreitungsstrategie: r-Stratege, 3. Gruppe; das Häufigkeitsmuster innerhalb des Fallennetzes entspricht interessanterweise dem der typischen Wanderfalter.

Acasis viretata (2 Individuen)

Distanzen: 1-2
Larvalökologie: bisher konnten, nach den in KOCH (1984) genannten Raupenfutterpflanzen beurteilt, keine biotopfremden Stücke nachgewiesen werden.
Populationsbiologie: im Gebiet univoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Nothopteryx polycommata (6 Individuen)

Distanzen: 1-2
Larvalökologie: bisher konnten, nach den in KOCH (1984) genannten Raupenfutterpflanzen beurteilt, keine biotopfremden Stücke nachgewiesen werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Nothopteryx carpinata (9 Individuen)

Distanzen: 1-2
Larvalökologie: die Raupe ist an Espe, Birke, Sal-Weide und Hainbuche zu finden. Bisher keine biotopfremden Tiere
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Lobophora halterata (2 Individuen)

Distanzen: vermutlich 2
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Pterapherapteryx sexalata (50 Individuen)

Distanzen: 2-3
Larvalökologie: die Raupe lebt oligophag an Weide und Pappel; die 150-300 m-Distanz vom Ruderal zum Standort HM wird in beiden Geschlechtern konstant und von zahlreichen Stücken bewältigt; in den Garten (die nächsten einzelstehenden Weiden befinden sich ca. 200 m entfernt) konnten bisher nur 2 zugeflogene Stücke nachgewiesen werden. Der Häufigkeitsgradient im Wasserwerk spricht für Barrieren gegen eine freie Mobilität dieser Art.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Operophthera brumata

228 Individuen 0 %* ♀-Rate

169 markiert 30 Wiederfänge

* die ♀♀ sind flügellos und werden daher mit Lichtfallenfängen nicht erfaßt.

Tab. 97: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Operophthera brumata* 1988; 1987 war ein schlechtes Flugjahr, es wurden nur 3 Individuen markiert.

1988	Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	60	64	8	7	-	18	-	3	22	8	190
Σ zus.	-	18	-	-	-	-	-	-	-	-	18
Mark.	53	79	8	7	-	16	-	3	-	-	166
W.f.	7	23	-	-	-	-	-	-	-	-	30

Wiederfang-Quote: hoch; in der Flugzeit 1988 erfolgte im Garten an beiden Standorten (SiN und WaS) bei zwei Ausnahmen der Lichtfang parallel und täglich.
Das Ergebnis verdeutlicht die Abhängigkeit vom Standort: An SiN konnten prozentual gesehen weniger ♂♂ rückgefangen werden, als an WaS.
Die mittlere Verweildauer liegt insgesamt mit 3,0 Tagen auf einem für diese Methodik hohen Niveau. Interessant sind die 3 längsten festgestellten Intervalle von 8, 11 und 16 Tagen. Die beiden letztgenannten ♂♂ überdauerten damit eine einwöchige Kälteperiode mit Temperatur<u>maxima</u> von -5 Grad Celsius. Die Nachttemperaturen betrugen bis zu 10 Grad Minus und es fielen ca. 10 cm Schnee.
Distanzen: ♂♂ 2, ♀♀ 1
Larvalökologie: die Raupen fressen an Laubgehölzen. Das an HM nachgewiesene ♂ stammt vermutlich aus dem Ruderal (150-300 m entfernt).
Verhältnismäßig große Nacht-zu-Nacht-Fluktuationen an SiN, dem mehr offenlandähnlichen der beiden Garten-Standorte weisen wohl auf einen erhöhten Anteil zugeflogener Tiere hin (siehe auch "Wiederfang-Quote"). Im gleichen Zeitraum waren die Fangergebnisse an WaS (30 m entfernt) recht konstant.
Populationsbiologie: siehe REICHHOLF (1984)
Verbreitungsstrategie: K-Stratege, 5. Gruppe; es handelt sich um keine K-Strategie im "klassischen" Sinn, da die ♀♀ vergleichsweise viele Eier produzieren (siehe REICHHOLF, l.c.); die Strategie ähnelt in manchen Aspekten der von *Alsophila aescularia* (siehe dort). Es zeigten sich allerdings deutlich längere Verweildauern der ♂♂ von O. brumata. Eine (Wind-)Verdriftung von Jungraupen, die sich an einem Faden abseilen, spielt bei dieser Art sicherlich eine Rolle (REICHHOLF, l.c.).

Oporinia dilutata

120 Individuen 18,0 % ♀-Rate

96 markiert 9 Wiederfänge

Wiederfang-Quote: durchschnittlich; 8 Wiederfänge erfolgten im Garten (67 Markierungen) bei täglichem Fang und erklären sich zum Großteil durch ein Festgehalten-Werden im Bann der Lichtwirkung. Ein ♂ wurde zum zweiten Mal wiedergefangen (nach 2 Ein-Tages-Intervallen) und ein anderes ♂ ging viermal in die Lichtfalle, wobei es vom 2. auf den 4. Tag den Ort wechselte (WaS→SiN = 30 m). Sonst lagen zwischen Fang und Wiederfang nur Intervalle von einem Tag.
Im Wasserwerk flog ein ♂ innerhalb von 2 Tagen mindestens 120 m (WNw→WNo). Hier waren 1988 10 Individuen markiert worden.
Distanzen: 2
Larvalökologie: wie die vorige Art an Laubbäumen; bisher konnte noch kein biotopfremdes Stück nachgewiesen werden (z.B. HM). Der Häufigkeitsgradient zwischen WaN und WNo auf nur 50 m Entfernung könnte für Barrieren gegen die freie Beweglichkeit von *O. dilutata* sprechen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Oporinia autumnata

46 Individuen 10,5 % ♀-Rate

32 markiert 3 Wiederfänge

Wiederfang-Quote: relativ hoch, Stichprobe noch zu klein; es handelt sich um zwei ♂♂ 1988 am Standort WaS (täglicher Betrieb der Falle), von denen eines nach einem Intervall von 1 Tag, das andere am 4. und 5. Tag nach der Erstmarkierung wiedergefangen wurden.
Distanzen: 1-2
Larvalökologie: die Raupe wird an Weide, Birke, Ahorn und Lärche gefunden, biotopfremde Tiere konnten bisher noch nicht beobachtet werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; *O. autumnata* scheint im Vergleich zur vorigen Art lokaler vorzukommen und ortstreuer zu sein, was mit dem weniger breiten Wirtspflanzenspektrum zusammenhängen könnte.

Triphosa dubitata (19 Individuen)

Distanzen: 2
Larvalökologie: der Anflug bzw. die Kolonisation der kleinen gartenähnlichen Fläche am Sendergebäude muß, nach den in KOCH (1984) genannten Futterpflanzen beurteilt, über ca. 350-400 m freies Gelände hinweg erfolgt sein.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Calocalpe cervinalis

110 Individuen 60,4 % ♀- Rate

89 markiert 2 Wiederfänge

Wiederfang-Quote: durchschnittlich; ein ♂ wechselte 1987 in einem Zeitintervall von 1 Tag den Ort (WaS→SiN = 30 m). Ein ♀ konnte im selben Jahr an WaM noch 10 Tage nach der Erstmarkierung nachgewiesen werden! In sich geschlossene Geländestrukturen scheinen die Verweildauern zu steigern.
Distanzen: 2, die ♀♀ vielleicht nur 1-2
Larvalökologie: monophag an Berberitze (*Berberis vulgaris*); biotopfremde Stücke konnten bisher noch nicht nachgewiesen werden, lediglich vom Standort HW ist das nächste Vorkommen der Futterpflanze ca. 150 m entfernt. Dementsprechend wurde auch nur 1 Individuum nachgewiesen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Philereme vetulata (154 Individuen)

Distanzen: 3
Larvalökologie: oligophag an Kreuzdorn (*Rhamnus cathartica*) und Faulbaum (*Frangula alnus*); die regelmäßig im Offenland (HM) auftauchenden Stücke (auch ein ♀) sind mindestens 800-1000 m geflogen und deuten auf hohe Dispersionsaktivitäten hin. Auch die zahlreichen HW-Exemplare stammen aus mindestens 150 m Entfernung.
Populationsbiologie: von Generation zu Generation treten z.T. starke Fluktuationen auf.
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Philereme transversata (19 Individuen)

Distanzen: 1-2; der Häufigkeitsgradient WaS/SiN auf nur 30 m Entfernung deutet auf geringe Dispersionsaktivitäten hin.
Larvalökologie: Larvalansprüche wie bei *P. vetulata*, zusätzlich wird noch Schlehe akzeptiert. Bisher konnten keine biotopfremden Tiere beobachtet werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Lygris prunata (36 Individuen)

Distanzen: 1-2; wie *P. transversata*
Larvalökologie: die Raupe ernährt sich von Stachelbeere, Johannisbeere, Schlehe, Weißdorn und Eiche; bisher keine biotopfremden Tiere
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Lygris testata (3 Individuen)

Distanzen: vermutlich 2
Larvalökologie: die Raupe bevorzugt Heidekraut (*Calluna*) und Heidelbeere (*Vaccinium*), da diese im Untersuchungsgebiet jedoch fast nicht verfügbar sind, weicht diese Art auf Espe, Weide und Birke aus. Solche Standorte dürften aber wohl als suboptimal zu charakterisieren sein. Bisher konnten keine biotopfremden Tiere festgestellt werden.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Lygris populata

Distanzen: vermutlich 2
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Lygris mellinata (6 Individuen)

Distanzen: 2-4
Larvalökologie: die Raupe ist auf Johannisbeere und Stachelbeere spezialisiert, bisher keine biotopfremden Stücke
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe; diese Art unternahm in den letzten ca. 50 Jahren eine Arealausweitung quer über ganz Südbayern, wobei zumindest schubweise auch größere Strecken von mehreren Kilometern bewältigt werden mußten.

Lygris pyraliata (116 Individuen)

Distanzen: 2
Larvalökologie: an Labkraut (*Galium*) und Bach-Nelkenwurz (*Geum rivale*); trotz der weiten Verbreitung im Untersuchungsgebiet konnten an HM keine Stücke nachgewiesen werden. Die Distanz von 1 km liegt offensichtlich nicht im Bereich der Dispersionsaktivität und des trivial movement dieser Art.
Verbreitungsstrategie: intermediärer Typ, 4. Gruppe

Cidaria fulvata (80 Individuen)

Distanzen: 2(-3)
Larvalökologie: die Raupe ist auf Rosen spezialisiert; im Wasserwerk ist in einer Entfernung von 100 m von einem Rosenbestand (WaN→WNw) ein Häufigkeitsabfall auf ca. die Hälfte zu beobachten. Das 1986 nach HM (ca. 1 km) zugeflogene Stück stellt wohl die Obergrenze der normalen Dispersionsaktivität oder vielleicht schon eine Ausnahme dar.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Plemyria rubiginata (75 Individuen)

Distanzen: 2-3
Larvalökologie: die Raupe lebt an Erle (*Alnus*); das HM-♂ (1988) legte mindestens 800 m vom nächstgelegenen Standort der Raupenfutterpflanze zurück. Die zahlreichen im Garten festgestellten Stücke müßten zumindest aus 200-300 m Entfernung gekommen sein, wenn nicht doch zuweilen auch auf andere Futterpflanzen ausgewichen wird.
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Thera variata (64 Individuen)

Distanzen: 2
Larvalökologie: *T. variata* ist an Nadelbäume gebunden. Der Nachweis für ein Sich-Entfernen von der Futterpflanze um 50 m wurde für eine Reihe von Standorten erbracht, die Distanz von 1 km (Zuflug nach HM) liegt jedoch außerhalb der normalen Dispersionsaktivität. Am Franzosenhölzl konnte 1989 ein ♀ ca. 500 m vom nächsten Nadelbaum (Fichte) entfernt gefangen werden (2. Generation).
Populationsbiologie: bivoltin, dazu zwei Exemplare einer 3. Generation; proterandrisch
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Thera obeliscata (113 Individuen)

Distanzen: 2(-3)
Larvalökologie: die Raupen fressen vor allem an Kiefern, vermutlich aber auch an Fichte und Wacholder; das an HM (1986) in einer windstillen Nacht festgestellte Exemplar stammt also aus mindestens 800 m Entfernung (Friedhof Hochmutting). In ca. 100 m Entfernung zum Standort HW stehen einige kleine Kiefern (ca. 2 m hoch), die als Herkunft für die beiden dort nachgewiesenen Falter in Frage kommen.
Populationsbiologie: eine 2. Generation wird zwar nachgewiesen, sie ist jedoch recht unvollständig.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; im Zuge einer günstigen Bestandsentwicklung kam es 1986 offenbar bei den meisten der an Kiefern gebundenen Arten zu Verbreitungsschüben.

Thera juniperata

53 Individuen 11,8 % ♀- Rate

34 markiert kein Wiederfang

Wiederfang-Quote: niedrig, Stichprobe noch zu klein
Distanzen: 2, bei Besiedelungsvorgängen auch 3

Larvalökologie: nach KOCH (1984) monophag an Wacholder (*Juniperus communis*), siehe jedoch die Bemerkungen unter "Verbreitungsstrategie". Biotopfremde Stükke konnten bisher noch nicht beobachtet werden.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; eine Arealausweitung, gestützt auf die in Gärten häufig angepflanzten Zierwacholder, erwähnt MEINECKE (1984). Solche Arealausweitungen fanden im Laufe dieses Jahrhunderts auch in Südbayern statt. Da Wacholder in der weiteren Umgebung des Untersuchungsgebietes nicht in der Natur vorkommt, bleibt nur eine Trittsteinbesiedlung über Wacholder in Gärten und Friedhöfen. Vermutlich kann die Art jedoch unter suboptimalen Bedingungen zumindest kurzzeitig auf andere Nadelhölzer zurückgreifen. Dies wird vor allem bei solchen Besiedelungsprozessen eine Rolle spielen.

Thera firmata

249 Individuen 61,2 % ♀- Rate

215 markiert 2 Wiederfänge

Tab. 98: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Thera firmata*.

1987	SIEDLUNG			WALD			HALBTROK-KENRASEN			"DACH. MOOS"	Σ
			Garten								
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	-	-	66	29	1	8	26	1	8	-	139
Σ zus.	-	-	19	23	-	5	-	-	-	-	47
♂♂	-	-	26	21	-	5	4	-	2	-	58
♀♀	-	-	52	23	1	8	18	1	5	-	108
Mark.	-	-	75	43	1	13	22	1	7	-	162
W.f.	-	-	1	-	-	-	-	-	-	-	1

1988	Garten		WALD Wasserwerk			HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	11	13	3	12	2	11	-	3	1	-	56
Σ zus.	-	7	-	-	-	-	-	-	-	-	7
♂♂	4	7	3	4	1	7	-	1	-	-	27
♀♀	3	13	-	5	-	4	-	1	-	-	26
Mark.	7	20	3	9	1	11	-	2	-	-	53
W.f.	-	1	-	-	-	-	-	-	-	-	1

Wiederfang-Quote: niedrig; 1987 wurde ein ♀ nach 3 Tagen, 1988 ein ♂ nach 1 Tag wiedergefangen.
Distanzen: 1-3
Larvalökologie: monophag an Kiefer; im Siedlungsbereich spiegelt sich die ökologische Trennung im Fangergebnis der verschiedenen Standorte gut wieder. Auch im Wasserwerk weist der Häufigkeitsgradient darauf hin, daß schon Entfernungen von ca. 100 m ein Hindernis für eine Verbreitung darstellen können.
Die immer wieder (in windigen Nächten) im Offenland (HM) auftauchenden Exemplare - 1987 auch ein fertiles ♀ - sind mindestens 800-1000 m geflogen und zeugen von weiten Vorstößen über biotopfremdes Gebiet. Im gleichen Sinn ist das 1988 am Würmkanal (Au) festgestellte ♂ zu verstehen; in einer Entfernung von ca. 200 m existiert eine ca. 10 Jahre alte Kiefernschonung.
Populationsbiologie: proterandrisch
Verbreitungsstrategie: K-Stratege, 5. Gruppe

Chloroclysta siterata (14 Individuen)

Distanzen: 2
Larvalökologie: an Laubhölzern, bisher keine biotopfremden Tiere; für die Überwinterung scheinen Häuser, Schuppen, Mauern und dergleichen von Vorteil zu sein.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Dystroma truncata (181 Individuen)

Distanzen: 2
Larvalökologie: recht polyphag, *D. truncata* ist jedoch eine typische Art der Wälder und deren Ränder. Das HM-Stück stammt mindestens aus dem Ruderal (150-300 m). Im Wasserwerk und im Garten besteht ein recht deutlicher Häufigkeitsgradient, der auf normale Flugaktivitäten von unter 200 m außerhalb des Habitats hinweist.
Populationsbiologie: bivoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Dystroma citrata (38 Individuen)

Distanzen: 1-2
Populationsbiologie: im Gegensatz zur vorigen Art univoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe; sowohl im Untersuchungsgebiet als auch in der unteren Hochebene Südbayerns lokaler verbreitet als *D. truncata*.

Xanthorhoe fluctuata (88 Individuen)

Distanzen: 2; die Häufigkeitsgradienten im Wasserwerk und im Garten sowie der bisher fehlende Nachweis an HM könnten als erste Hinweise dafür verstanden werden, daß im "trivial movement" die Maximaldistanzen einige 100 m betragen.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Xanthorhoe montanata (27 Individuen + tagsüber > 500 Exemplare)

Distanzen: 1-2
Larvalökologie: für das lokal so überaus zahlreiche Auftreten im Birket stellt vermutlich die Häufigkeit der Himbeere die Ursache dar.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Xanthorhoe spadicearia (381 Individuen)

Distanzen: 2(-3?); das polarisierte Häufigkeitsverhältnis WaN/WNo auf nur 50 m Distanz deutet vielleicht auf Barrieren gegen die freie Mobilität dieser Art hin. Im Vergleich zur recht ähnlichen *X. ferrugata* dominiert *X. spadicearia* zahlenmäßig im Wasserwerk, im Garten sind die Dominanzverhältnisse umgekehrt. Zwischen diesen beiden Standorten (1,2-1,3 km Distanz) findet vermutlich kein nennenswerter Austausch statt.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Xanthorhoe ferrugata

siehe Versetzexperiment (8.4.)

1023 Individuen 45,2 % ♀- Rate

406 markiert 25 Wiederfänge

Tab. 99: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Xanthorhoe ferrugata.*

1987	SIEDLUNG			WALD			HALBTROKKENRASEN			"DACHMOOS"	Σ
			Garten								
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	1	9	15	63	8	33	46	5	41	15	236
Σ zus.	-	4	34	22	-	9	6	-	-	1	76
♂♂	1	1	11	22	6	21	17	3	10	4	96
♀♀	-	3	11	16	1	3	8	2	7	-	51
Mark.	1	4	22	38	6	24	25	5	17	4	146
W.f.	-	-	-	-	-	1	-	-	-	-	1

1988	WALD					HALBTROKKENRASEN			"DACHMOOS"		Σ
	Garten		Wasserwerk								
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	<47	230	42	19	29	29	2	22	16	4	440
Σ zus.	-	271	-	-	-	-	-	-	-	-	271
♂♂	10	91	9	6	6	7	2	1	2	-	134
♀♀	8	123	3	2	2	1	-	-	-	-	139
Mark.	15	208	10	7	8	8	1	1	2	-	260
W.f.	2	20	2	-	-	-	-	-	-	-	24

Wiederfang-Quote: in beiden Generationen niedrig, im Wasserwerk dagegen höher; Fast alle der Wiederfänge erklären sich durch ein Festgehalten-Werden im Bann des Lichtes: Im Garten erfolgten 21 von 22 Rückfängen nach einem Intervall von 1 Tag, nur 1 ♂ war nach 2 Tagen wiedergefangen worden. Zwei ♂♂ wechselten dabei von WaS nach SiN (30 m). Es ereignete sich nur 1 Zweitwiederfang.
Im Wasserwerk konnten unter "regulären" Bedingungen (dazwischenliegende fangfreie Nacht) 1987 ein ♂ 3 Tage nach der Markierung nachgewiesen werden. 1988 wurden zwei den Standort wechselnde ♂♂ beobachtet: Es wurden hierbei die Strecken WNo→WaN (50 m) in 2 Tagen und WNw→WaN (100 m) in 10 Tagen zurückgelegt.
Die ♀-Rate im Wiederfangergebnis entspricht in etwa der der Erstfänge.
Distanzen: in beiden Generationen 2-3; im Offenland wird die Art bevorzugt in Nächten mit Wind nachgewiesen.
Populationsbiologie: bivoltin, in beiden Generationen proterandrisch; der ♀-Rate von 29,0 % in der 1. Generation stehen 52,0 % in der 2. Generation gegenüber. Am Standort WaS war diese Differenz bei einem Verhältnis von 32,2 % / 62,2 % noch größer.
Verbreitungsstrategie: r-Stratege, 2. Gruppe

Xanthorhoe biriviata (10 Individuen + tagsüber 2 Exemplare)

Distanzen: 2
Larvalökologie: monophag am Echten Springkraut (*Impatiens noli-tangere*); in der Falle konnten bisher keine biotopfremden Tiere nachgewiesen werden, die beiden tagsüber im Moos bei prallem Sonnenschein aktiven Exemplare flogen jedoch entlang einer Hecke an einer Stelle, die ca. 100 m von der nächsten Raupenfutterpflanze entfernt ist. Langgestreckte Landschaftselemente wie Hecken oder Bachbegleitfloren können also bei der Verbreitung von relativ spezialisierten silvicolen Arten eine gewichtige Rolle spielen.
Populationsbiologie: bivoltin
Verbreitungsstrategie: K-Stratege, 5. Gruppe

Xanthorhoe designata (4 Individuen)

Distanzen: vermutlich 2
Populationsbiologie: bivoltin
Verbreitungsstrategie: vermutlich K-Stratege, 5. Gruppe

Ochyria quadrifasciata (363 Individuen)

Distanzen: 2; das stark polarisierte Häufigkeitsverhältnis WaS/SiN sowie die Tatsache, daß im Offenland (HM) nur einmal ein ♂ in einer windigen Nacht gefangen wurde, charakterisieren diese im Vergleich zu den *Xanthorhoe*-Arten eigentlich flugkräftig erscheinende Art als einen recht biotoptreuen Waldbewohner. Das HM-Stück flog vermutlich aus dem Ruderal (150-300 m) herbei.
Populationsbiologie: im Untersuchungsgebiet abgesehen von 1 Exemplar, das Anfang September gefangen wurde, nur univoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Nycterosea obstipata (1 Individuum)

Distanzen: 4
Verbreitungsstrategie: r-Stratege, 1. Gruppe

Calostigia olivata (14 Individuen)

Distanzen: 2
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Calostigia pectinataria (82 Individuen)

Distanzen: 2
Larvalökologie: die Raupen fressen an Labkraut, Brennessel und Taubnessel; die beiden an HM festgestellten Stücke stammen zumindest aus dem Ruderal (150-300 m).
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Lampropteryx ocellata (65 Individuen)

Distanzen: 1-2; die Häufigkeitsgradienten im Wasserwerk (auf 50 m Entfernung) und im Garten (30 m) könnten Hinweise darauf sein, daß diese Art schon mit der Bewältigung solch kurzer Distanzen Probleme hat.
Larvalökologie: die Raupen ernähren sich von Labkrautarten. Der fehlende Nachweis in der Mitte des Flughafens (HM) deutet auf Dispersionsaktivitäten unter 1 km hin.
Populationsbiologie: bivoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Lampropteryx suffumata (14 Individuen)

Distanzen: 2
Larvalökologie: auch diese Art ist auf verschiedene Labkrautarten spezialisiert, die Habitatbindung scheint stärker zu sein als bei *L. ocellata.*
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Coenotephria berberata (210 Individuen)

Distanzen: 2-3
Larvalökologie: monophag an Berberitze (*Berberis vulgaris*); das HM-♂ (1987) mußte vom Ort der Larvalentwicklung aus mindestens 800-1000 m weit geflogen sein.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Euphyia cuculata (70 Individuen)

Distanzen: 2
Larvalökologie: die Raupe ist an Labkrautarten zu finden, die 3 HM-Stücke stammen vermutlich aus dem Ruderal (150-300 m).
Populationsbiologie: im Untersuchungsgebiet wurde bisher nur 1 Generation festgestellt.
Verbreitungsstrategie: K-Stratege, 5. Gruppe

Euphyia molluginata (4 Individuen)

Distanzen: vermutlich 1-2
Larvalökologie: wie *E. cuculata*, bisher konnten keine biotopfremden Stücke beobachtet werden.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Euphyia bilineata (126 Individuen + tagsüber viele weitere Exemplare)

Distanzen: 2-3; das stark polarisierte Häufigkeitsverhältnis im Garten (SiN/WaS) spricht für Barrieren gegen die freie Mobilität dieser Art.
Populationsbiologie: *E. bilineata* fliegt im Untersuchungsgebiet in einer partiellen 2. Generation
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Diactinia capitata (3 Individuen)

Distanzen: vermutlich 1-2
Larvalökologie: monophag an Echtem Springkraut (*Impatiens noli-tangere*); bisher konnten noch keine biotopfremden Tiere beobachtet werden.
Populationsbiologie: im Untersuchungsgebiet steht der Nachweis einer 2. Generation noch aus.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Diactinia silaceata (43 Individuen)

Distanzen: 2
Larvalökologie: oligophag an Weidenröschen (*Epilobium*), Echtem Springkraut und Großem Hexenkraut (*Circaea lutetiana*) lebend; bisher wurden alle Exemplare in der Nähe der Raupenfutterpflanzen gefangen.
Populationsbiologie: bivoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe; die Dispersionsaktivitäten dieser Art scheinen im Vergleich zu *D. capitata* einhergehend mit dem erweiterten Wirtspflanzenspektrum auf einem etwas höheren Niveau zu liegen.

Electrophaes corylata (14 Individuen)

Distanzen: 2
Larvalökologie: oligophag an einigen Laubhölzern, bisher keine biotopfremden Tiere
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Mesoleuca albicillata (30 Individuen + tagsüber viele weitere Exemplare)

Distanzen: 1-2; auch die in der Dämmerung gemachten Beobachtungen deuten auf geringe Dispersionsaktivitäten hin.
Larvalökologie: die Raupen sind auf Him- und Brombeere spezialisiert; bisher wurden alle Exemplare in der unmittelbaren Nähe der Futterpflanzen beobachtet
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Melanthia procellata (5 Individuen)

Distanzen: 2 (-4 ?)
Larvalökologie: monophag an Gemeiner Waldrebe (*Clematis vitalba*); bisher konnten keine biotopfremden Tiere nachgewiesen werden.
Populationsbiologie: im Untersuchungsgebiet bivoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe; KOCH (1984) berichtet von der Neukolonisation Sachsens innerhalb von einigen Jahren; hierbei müssen größere Strekken zurückgelegt worden sein; solch große Distanzen liegen jedoch vermutlich nicht im Bereich des "trivial movement" dieser Art.

Epirrhoe tristata

364* Individuen	20 %** ♀- Rate
10 markiert	kein Wiederfang

* tagsüber viele weitere Exemplare ** Stichprobe zu klein

Wiederfang-Quote: Stichprobe zu klein
Distanzen: 1. Generation 1-2; 2. Generation 2-3; im Wasserwerk fällt der starke Häufigkeitsgradient schon auf einer Distanz von nur 50 m auf (WaN/WNo).
Larvalökologie: die Raupen ernähren sich von Labkrautarten; die beiden HM-Stükke stammen vermutlich aus dem Ruderal (150-300 m). Im Garten konnte *E. tristata* bisher nur in der 2. Generation nachgewiesen werden. Vielleicht sind dafür zufliegende Individuen mit erhöhter Dispersionsaktivität (im Vergleich zur 1. Generation) verantwortlich.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Epirrhoe alternata (766 Individuen + tags viele weitere Exemplare)

Distanzen: 3; ein ♀ wurde tagsüber bei einem 500 m weiten Flug beobachtet, diese Distanzen scheinen innerhalb der Grenzen der normalen Dispersionsaktivität zu liegen.
Larvalökologie: wie *E. tristata*; im reinen Offenland (HM) ist diese Art häufiger als die vorige Art anzutreffen. Im Garten erscheint sie schon in der 1. Generation. Bevorzugter Lebensraum ist der Brennessel-Giersch-Saum (*Urtico dioicae-Aegopodietum*), wenn dieser gut mit Klebkraut (*Galium aparine*) durchmischt ist.
Populationsbiologie: bivoltin
Verbreitungsstrategie: r-Stratege, 2. Gruppe

Perizoma alchemillata (233 Individuen)

Distanzen: 2 (-3?)
Larvalökologie: nach den in KOCH (1984) genannten Raupenfutterpflanzen beurteilt, handelt es sich bei den beiden im Offenland (HM) beobachteten Stücken um Gäste, die zumindest aus dem Ruderal stammen (150-300 m)
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Perizoma bifaciata (1 Individuum)

Distanzen: vermutlich 2
Larvalökologie: oligophag an Gelbem Zahntrost (*Orthanta lutea*) und Gemeinem Augentrost (*Euphrasia officinalis*). Letztgenannte Pflanze ist im Flughafengebiet verbreitet. Ob das Stück von dorther in den Siedlungsbereich eingeflogen ist, läßt sich im Moment nicht klären, bodenständig ist die Art jedoch im Garten sicherlich nicht.
Populationsbiologie: die Puppe überliegt nach KOCH (1984) meist mehrmals, was die potentielle Wachstumsrate der Populationen dieser Art drastisch reduziert.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Perizoma blandiata

Distanzen: vermutlich 2
Larvalökologie: monophag an Gemeinem Augentrost (*Euphrasia officinalis*); siehe Bemerkungen zu *P. bifaciata*
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Perizoma flavofasciata (3 Individuen)

Distanzen: 3
Larvalökologie: auf Lichtnelken (*Silene*) spezialisiert; auf ein Auftreten der Futterpflanzen kann bisweilen sehr rasch mit einem Kolonisationsversuch geantwortet werden, wie dies 1986 schon im ersten Jahr der Verfügbarkeit der Futterquelle geschah. Gemäß dem unsteten Auftreten der Wirtspflanzen dürften auch die beobachteten hohen Austauschraten im Untersuchungsgebiet eine Anpassung an dieses Phänomen darstellen.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Hydriomena furcata (71 Individuen)

Distanzen: 2
Larvalökologie: *H. furcata* ist an das Vorhandensein von Weiden oder Heidelbeeren (*Vaccinium myrtillus*) gebunden. Die im Garten festgestellten Tiere müssen also aus mindestens 200 m Entfernung zugeflogen sein, die HW-Stücke aus 150 m, jeweils ohne Sichtkontakt zur Lichtquelle.
Verbreitungsstrategie: K-Stratege, 5. Gruppe

Hydriomena coerulata

91 Individuen 15,4 % ♀- Rate

26 markiert 1 Wiederfang

Wiederfang-Quote: hoch, Stichprobe noch zu klein. Im Wasserwerk konnte 1988 ein Ortswechsler (WaN→WNo = 50 m) nach 2 Tagen (♂) festgestellt werden.
Distanzen: 1-2; der Häufigkeitsgradient im Wasserwerk auf 50 bzw. 100 m Distanz, sowie der starke Häufigkeitsabfall im Franzosenhölzl 1989 schon 40 m außerhalb des Wäldchens (2 Individuen gegenüber 15 am Rand) sprechen für geringe Dispersionsaktivitäten.
Larvalökologie: die Raupe ernährt sich von einigen Laubbäumen und Heidelbeere; im reinen Offenland (HM) wurde noch kein Nachweis erbracht.
Populationsbiologie: wenig proterandrisch
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Anticlea badiata (6 Individuen)

Distanzen: 1-2
Larvalökologie: die Raupen sind auf Rosen spezialisiert; bisher keine biotopfremden Tiere
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Pelurga comitata (6 Individuen)

Distanzen: vermutlich 2 (-3?)
Populationsbiologie: die Puppe überwintert nach KOCH (1984) gelegentlich zweimal, was die potentielle Wachstumsrate der Populationen dieser Art verringert.
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe; GYULAI & VARGA (1974) berichten allerdings von gerichteten Bewegungen innerhalb des Areals dieser Art.

Hydrelia testaceata (69 Individuen)

Distanzen: 1-2
Larvalökologie: die Raupe ist auf Erle spezialisiert, vielleicht nimmt sie jedoch auch Birke und Weide an. Das im Garten gefundene Stück könnte somit von einer zumindest kurzzeitigen Besiedlung der dortigen Birken zeugen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Hydrelia flammeolaria (89 Individuen)

Distanzen: 2
Larvalökologie: oligophag an verschiedenen Laubbäumen; im Offenland (HM) bisher noch nie gefunden, Dispersionsaktivitäten daher wohl deutlich kleiner als 1 km
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Euchoeca nebulata (131 Individuen)

Distanzen: 2
Larvalökologie: oligophag an Erle und Birke; im Offenland (HM) bisher noch nie gefunden, Dispersionsaktivitäten daher wohl deutlich kleiner als 1 km
Populationsbiologie: bivoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Asthena albulata (10 Individuen)

Distanzen: vermutlich 2
Larvalökologie: oligophag an einigen Laubbäumen, bisher keine biotopfremden Tiere
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe; wie auch andere Entomologen berichten, ist diese Art wie auch die folgende in Südbayern in den letzten beiden Jahren plötzlich häufiger geworden. Die Flugleistungen der *Asthena*-Arten können jedoch nicht so stark und die potentielle Wachstumsrate der Populationen nicht so groß sein, daß diese Art in so kurzen Zeitabschnitten zu einer "Überschwemmung" Südbayerns fähig wäre. Vermutlich ist diese Entwicklung einer günstigen Konstellation der Futterpflanzenentwicklung unter den gegebenen Klimabedingungen zuzuschreiben. Vielleicht spielen weitere Faktoren herein, jedoch beispielsweise eine Verminderung des Feinddruckes durch Parasiten, der zwar art- bzw. gattungsspezifisch wäre, müßte dann auch synchron auf einer sehr großen Fläche stattgefunden haben, was recht unglaubhaft ist.
Ein derartiges jahrweise häufiges Auftreten synchron in größeren Gebietsteilen ist auch für viele *Eupithecia*-Arten typisch.

Asthena anseraria (3 Individuen)

Distanzen: vermutlich 1-2
Larvalökologie: monophag am Blutroten Hartriegel (*Cornus sanguinea*), welcher im Wasserwerk in unmittelbarer Nähe der Fundorte vorkommt.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; siehe Bemerkungen zu *A. albulata*

Eupithecia tenuiata (19 Individuen)

Distanzen: 2
Larvalökologie: monophag an Sal-Weide (*Salix caprea*); die 4 im Garten gefundenen Stücke waren mindestens 200 m, die 6 HW-Stücke mindestens 150 m von der nächstgelegenen Futterpflanze her geflogen. Das an HM 1986 festgestellte Tier stammt höchstwahrscheinlich aus dem Ruderal (150-300 m). Diese Daten charakterisieren *E. tenuiata* als eine vergleichsweise mobile Eupithecie.
Populationsbiologie: wenig proterandrisch, ♀-Rate 50,0 %
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Eupithecia inturbata (16 Individuen)

Distanzen: 2; der starke Häufigkeitsgradient im Wasserwerk spricht für Barrieren gegen die freie Mobilität dieser Art schon auf 50 m Distanz.
Larvalökologie: monophag am Feld-Ahorn (*Acer campestre*); die im Garten festgestellten Exemplare müssen mindestens 100 m weit geflogen sein.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; *E. inturbata* gehört zu der Gruppe der eigentlich als selten geltenden Arten, die in den letzten Jahren ihre Bestände vergrößern konnten (siehe Bemerkungen zu *Asthena albulata*).

Eupithecia plumbeolata (5 Individuen)

Distanzen: vermutlich 2
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Eupithecia pini (1 Individuum)

Distanzen: vermutlich 1-2
Larvalökologie: an Nadelbäumen, v.a. Gemeine Fichte (*Picea abies*) und Kiefer (*Pinus*); bisher keine biotopfremden Tiere
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Eupithecia bilunulata

Distanzen: vermutlich 1-2
Larvalökologie: die Raupen sind sehr spezialisiert und leben in den Gallen von Fichtenläusen an der Gemeinen Fichte; alle 1983 und 1989 nachgewiesenen Tiere wurden in unmittelbarer Nähe der Wirtspflanzen festgestellt.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Eupithecia linariata (4 Individuen)

Distanzen: vermutlich 2
Larvalökologie: monophag am Gemeinen Leinkraut (*Linaria vulgaris*); das im Garten festgestellte, etwas geflogene Stück mußte mindestens 300 m weit geflogen sein.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Eupithecia exiguata (41 Individuen)

Distanzen: 1-2
Larvalökologie: an verschiedenen Laubhölzern, v.a. an Sträuchern, bisher keine biotopfremden Tiere festgestellt
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Eupithecia valerianata (5 Individuen)

Distanzen: vermutlich 2
Larvalökologie: die Raupe ernährt sich monophag vom Echten Baldrian (*Valeriana officinalis*); diese Pflanze kommt im Radius von ca. 200 m um die Fangplätze im Garten nicht vor. Das hier beobachtete Stück muß also mindestens so weit geflogen sein.
Populationsbiologie: die Puppe überwintert nach KOCH (1984) manchmal zweimal, was die potentielle Waschstumsrate der Populationen ("PGR") vermindert.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Eupithecia venosata (6 Individuen)

Distanzen: 1-2
Larvalökologie: die Raupe ernährt sich von Taubenkropf (*Silene vulgaris*), im Garten jedoch wahrscheinlich von der Roten Lichtnelke (*Silene dioica*). Bisher konnten keine biotopfremden Tiere festgestellt werden.
Populationsbiologie: die Puppe überwintert nach KOCH manchmal zwei bis dreimal; dies verringert die "PGR" (siehe oben) und kann auch zur Vortäuschung von Turnover-Ereignissen führen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; das fakultative Überliegen der Puppen ist vielleicht eine Möglichkeit der Kompensation von ungünstigen Bestandsentwicklungen in schlechten Jahren: Wenn einmal eine (apparente) Extinktion einer Population eintritt, hat die Art immer noch einige Puppen "auf Vorrat".

Eupithecia egenaria (3 Individuen)

Distanzen: 1
Larvalökologie: monophag an der Sommerlinde (*Tilia platyphyllos*), das HO-♂ wurde 20 m, das im Garten beobachtete Stück 15 m von der Futterpflanze entfernt gefunden. Das dritte Exemplar wurde direkt an der Futterpflanze gefangen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Eupithecia extraversaria (14 Individuen)

Distanzen: vermutlich 2
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Eupithecia centaureata (22 Individuen)

Distanzen: 2-3
Larvalökologie: vergleichsweise polyphag an niedrigen Pflanzen; im Garten tritt diese Art jedoch vermutlich nur als Gast auf.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Eupithecia selinata (7 Individuen)

Distanzen: vermutlich 2
Populationsbiologie: im Untersuchungsgebiet univoltin
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Eupithecia trisignaria (6 Individuen)

Distanzen: vermutlich 2
Populationsbiologie: im Untersuchungsgebiet offensichtlich bivoltin, wie in FORSTER & WOHLFAHRT (1981) beschrieben
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Eupithecia intricata

180 Individuen   21,7 %* ♀- Rate

23* markiert   2* Wiederfänge   *E5-M6 1989

Wiederfang-Quote: die Art wurde nur in einigen Nächten 1989 an den Standorten WaS und SiN markiert. Es lagen fast stets fangfreie Nächte dazwischen, so daß die Wiederfang-Quote als relativ hoch zu werten ist (Stichprobe jedoch noch zu klein). Je ein ♂ wurde nach ein bzw. zwei Tagen wiedergefangen.
Distanzen: 1-2; das Häufigkeitsverhältnis SiN/WaS war schon auf einer Strecke von 30 m in allen Jahren deutlich polarisiert.
Larvalökologie: nach KOCH (1984) monophag an Wacholder (*Juniperus communis*). An einem solchen als Zierpflanze verwendeten Wacholder im Garten wurden wiederholt in der Dämmerung ♀♀ bei der Eiablage beobachtet. Dieser Strauch liegt direkt neben dem Standort SiN. Von WaS, an dem die relative Häufigkeit der Imagines deutlich höher ist, liegt jedoch das nächste Futterpflanzen-Vorkommen weiter entfernt (20-30 m). Entweder nimmt die Art auch Fichte als Futter an (siehe Bemerkungen bei *Thera juniperata*) oder die Falter ziehen sich nach dem Schlüpfen an geschütztere Standorte zurück, wo die Gefahr einer Verfrachtung durch Wind und der Feinddruck (z.B. Fledermäuse) kleiner sind.
Populationsbiologie: wenig proterandrisch
Verbreitungsstrategie: K-Stratege, 6. Gruppe; *E. intricata* gehört zur Gruppe der in Südbayern als selten geltenden Arten, die in den letzten Jahren häufiger geworden sind (siehe Bemerkungen zu *Asthena albulata*). Die Aussagen zur Strategie von *Thera juniperata* gelten vermutlich auch für diese Art.

Eupithecia satyrata (17 Individuen)

Distanzen: 2
Larvalökologie: vergleichsweise polyphag an niedrigen Pflanzen
Verbreitungsstrategie: K-Stratege, 5. Gruppe

Eupithecia tripunctaria (51 Individuen)

Distanzen: 2 (-3?)
Larvalökologie: *E. tripunctaria* zeichnet sich durch einen Wirtswechsel aus: die Raupen der 1. Generation fressen an den Blüten des Holunders (*Sambucus nigra*), die der 2. Generation an den Blüten von Bärenklau (*Heracleum*) und Engelwurz (*Angelica*); die Flugzeiten liegen jeweils kurz vor den Blütezeiten der betreffenden Pflanzen. Das SiM-Stück muß mindestens 100 m weit geflogen sein. Im reinen Offenland (HM) konnte bisher noch kein Exemplar nachgewiesen werden.

Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe; Durch den Wirtswechsel wird sicherlich in einigen Fällen ein Ortswechsel nötig. So wurde *E. tripunctaria* im Garten in der 1. Generation nur in 2 Exemplaren gefunden, während die 2. Generation häufig ist. Dieser Befund steht im Einklang mit der Verbreitung der Futterpflanzen: Holunder kommt 10 m vom Standort WaS entfernt vor, die Umbelliferen dagegen in einem Radius von mindestens 100 m nicht.

Eupithecia absinthiata (7 Individuen)

Distanzen: vermutlich 2
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Eupithecia assimilata (8 Individuen)

Distanzen: vermutlich 1-2
Larvalökologie: nach KOCH (1984) ernährt sich die Raupe nur von wildwachsendem Gemeinem Hopfen (*Humulus lupulus*) und von Schwarzer Johannisbeere (*Ribes nigrum*). CARTER & HARGREAVES (1987) geben darüber hinaus auch die Rote Johannisbeere (*Ribes rubrum*) an, die vermutlich die Lebensgrundlage der Population im Garten darstellt. Bisher konnten keine biotopfremden Tiere festgestellt werden.
Populationsbiologie: bivoltin
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Eupithecia vulgata (56 Individuen)

Distanzen: 2
Larvalökologie: polyphag an niedrigen Pflanzen, im Untersuchungsgebiet ist diese Art dennoch relativ lokal verbreitet.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Eupithecia castigata (153 Individuen)

Distanzen: 2-3
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Eupithecia icterata (46 Individuen)

Distanzen: 2; im Wasserwerk fällt der Häufigkeitsgradient zwischen WaN und WNo schon auf 50 m Distanz auf.
Larvalökologie: an Gemeiner Schafgarbe (*Achillea millefolium*) und Gemeinem Rainfarn (*Tanacetum vulgare*), dennoch konnte *E. icterata* bisher nicht an HM nachgewiesen werden.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; im Garten fand 1987 offensichtlich eine Neubesiedelung statt. Vorher konnte diese auffällige Art trotz intensiver Fänge nicht nachgewiesen werden.

Eupithecia succenturiata (21 Individuen)

Distanzen: 2
Larvalökologie: wie *E. icterata*, zusätzlich nehmen die Raupen auch Gemeinen Beifuß (*Artemisia vulgaris*) an.
Populationsbiologie: im Garten sind starke Häufigkeitsschwankungen festzustellen.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe;

Eupithecia subumbrata (30 Individuen)

Distanzen: 1-2
Larvalökologie: an Umbelliferen und Compositen, im Untersuchungsgebiet relativ stark an die trockeneren Wiesen gebunden; außerhalb davon, z.B. im Siedlungsgebiet konnte noch kein Stück nachgewiesen werden, was für Dispersionsaktivitäten spricht, die normalerweise in einem Bereich von unter 500 m liegen. Die (Trittstein-)Besiedelung des Wasserwerks in den letzten 10 Jahren erforderte jedoch Sprünge von 100-300 m.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Eupithecia millefoliata (4 Individuen)

Distanzen: 2 (4); *E. millefoliata* ist eine in der Ausbreitung begriffene östliche Steppenart; abgesehen vom Erstnachweis für Südbayern in Paitzkofen bei Straubing in einer Entfernung von 100 km (WOLFSBERGER, 1974) wurden aus Südbayern bisher keine Fundorte gemeldet.
Larvalökologie: monophag an Gemeiner Schafgarbe; bisher konnten keine biotopfremden Tiere nachgewiesen werden
Verbreitungsstrategie: in einer Arealerweiterung begriffen; wenn die Art an günstigen Stellen bodenständig wird, dann handelt es sich um einen K-Strategen der 6. Gruppe.

Eupithecia sinuosaria (4 Individuen)

Distanzen: 3-4; auch diese östliche Art hat in den letzten 30 Jahren seit dem Erstnachweis in Südbayern ihr Areal stetig nach Südwesten erweitert. Sie kam hierbei durchschnittlich ca. 5-10 km pro Jahr voran. Siehe hierzu REZBANYAI-RESER & WHITEBREAD (1987).
Verbreitungsstrategie: in einer Arealerweiterung begriffen, sonst vermutlich intermediärer Typ, 5. Gruppe

Eupithecia indigata (12 Individuen)

Distanzen: 1-2
Larvalökologie: auf Wald-Kiefer (*Pinus sylvestris*) und Gemeine Fichte (*Picea abies*) spezialisiert. Bisher wurden alle Exemplare an den Standorten der Futterpflanzen gefangen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Eupithecia pimpinellata

Distanzen: vermutlich 2
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Eupithecia innotata (4 Individuen)

Distanzen: vermutlich 2-3
Larvalökologie: *E. innotata* ist - ähnlich *E. tripunctaria* - durch einen Wirtswechsel charakterisiert: Die Raupen der 1. Generation leben an einigen Sträuchern und an Esche (*Fraxinus excelsior*), die der 2. Generation an Beifuß-Arten (*Artemisia*).
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; durch den Wirtswechsel wird sicherlich in einigen Fällen ein Ortswechsel nötig. Die im Garten festgestellten Stücke stammen aus mindestens 100 m Entfernung.

Eupithecia virgaureata (80 Individuen)

Distanzen: 2 (-3?)
Larvalökologie: Auch diese Art durchläuft einen obligatorischen Wechsel der Wirtspflanzen: Von Schlehe (*Prunus spinosa*) und Weißdorn (*Crataegus*) ernähren sich die Raupen der 1. Generation, die der zweiten dagegen von Echter Goldrute (*Solidago virgaurea*), Gemeinem Greiskraut (*Senecio vulgaris*) oder Gemeinem Wasserdost (*Eupatorium cannabinum*). Da an einer Reihe der Fundorte der Imagines diese Futterpflanzenkombination in einer Entfernung von 100-200 m nicht vorkommt, ist diese Art als vergleichsweise mobile Eupithecie anzusprechen.
Populationsbiologie: bivoltin; weder Proterandrie noch Protogynie; in der 2. Generation zeigte sich eine hohe ♀-Rate von 76,7 % (1988).
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe; durch den Wirtswechsel wird sicherlich in einigen Fällen ein Ortswechsel nötig. *E. virgaureata* gehört zur Gruppe der als selten geltenden (und wohl oft nur übersehenen) Eupithecien, die in den letzten Jahren häufiger nachgewiesen werden (siehe Bemerkungen zu *Asthena albulata*).

Eupithecia abbreviata

Distanzen: vermutlich 1-2
Larvalökologie: monophag an Eiche, die am Fundort vorkommt
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Eupithecia dodoneata

Distanzen: vermutlich 1-2
Larvalökologie: wie *E. abbreviata*
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe; die drei 1989 im Garten gefangenen ♀♀ sind die Erstnachweise für das südbayerische Faunengebiet (HAUSMANN in Vorber.)! *E. dodoneata* wird wahrscheinlich oft übersehen.

Eupithecia sobrinata (1 Individuum)

Distanzen: 1-2
Larvalökologie: monophag am Gemeinen Wacholder; alle Tiere wurden bisher in der unmittelbaren Nähe der Futterpflanzen gefangen.
Populationsbiologie: die Häufigkeit schwankt im Garten beträchtlich
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Eupithecia lariciata (5 Individuen)

Distanzen: 1-2
Larvalökologie: monophag an Europäischer Lärche (*Larix decidua*), bisher konnten keine biotopfremden Tiere nachgewiesen werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Eupithecia tantillaria (70 Individuen)

Distanzen: 1-2
Larvalökologie: die Raupen sind auf Gemeine Fichte spezialisiert, gelegentlich wird auch Europäische Lärche akzeptiert; die Häufigkeitsgradienten im Garten und im Wasserwerk, die einen starken Häufigkeitsabfall schon in 20-50 m Entfernung zur nächsten Futterpflanze erkennen lassen, sprechen für Barrieren gegen die freie Beweglichkeit. Im gleichen Sinn ist wohl der fehlende Nachweis im Offenland (HM) zu interpretieren.
Andererseits konnte 1989 im Franzosenhölzl zwei fertile ♀♀ 500 m von der nächsten Fichtengruppe entfernt gefangen werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Eupithecia lanceata (32 Individuen)

Distanzen: 1-2
Larvalökologie: monophag an der Gemeinen Fichte; der deutliche Häufigkeitsgradient im Wasserwerk auf ca. 100 m Distanz spricht für Barrieren, die gegen eine freie Beweglichkeit gerichtet sind.
Das 1986 an HM nachgewiesene ♂ stammt aus mindestens 800-1000 m Entfernung. Die Bewältigung einer solchen Distanz ist jedoch wohl als absolute Ausnahme zu verstehen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Chloroclystis v-ata (165 Individuen)

Distanzen: 2-3
Larvalökologie: nach den in KOCH (1984) genannten Raupenfutterpflanzen beurteilt, stammt das HM-Exemplar (1987) mindestens aus dem Ruderal, wo in ca. 200-250 m Entfernung die ersten Wirtspflanzen wachsen. Die Distanz von 1 km (Zuflug vom Flughafenrand nach HM) scheint jedoch nicht mehr im normalen Dispersionsgeschehen bewältigt zu werden.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 2. Gruppe; KOCH (l.c.) bezeichnet *C. v-ata* als "Arealausbreiter".

Calliclystis chloerata (6 Individuen)

Distanzen: vermutlich 2
Larvalökologie: monophag an Schlehe (*Prunus spinosa*); bisher konnten keine biotopfremden Tiere festgestellt werden.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe; der Erstnachweis dieser Art für Südbayern wurde erst durch WOLFSBERGER (1950; 1958) erbracht. Ob dies auch bei *C. chloerata* auf Arealerweiterungen zurückzuführen ist, oder ob die Art nur so lange mit *C. rectangulata* verwechselt wurde ist derzeit schlecht zu beurteilen.

Calliclystis rectangulata (111 Individuen)

Distanzen: 2
Larvalökologie: die Raupen sind auf Apfel- und Birnbäume spezialisiert (*Malus domestica* und *Pyrus communis*), nach CARTER & HARGREAVES (1987) wird gelegentlich auch Schlehe angenommen, was z.B. im Falle der WNo-Stücke als Entwicklungsort der Raupen sehr wahrscheinlich ist. Die beiden erstgenannten Pflanzen sind auch von einer Reihe weiterer Fundorte mehrere 100 m entfernt. Die Distanz von 1 km (Zuflug vom Flughafenrand nach HM) liegt nicht im Bereich des normalen Dispersionsgeschehens von *C. rectangulata*.
Verbreitungsstrategie: K-Stratege, 4. Gruppe

Horisme tersata (16 Individuen)

Distanzen: 1-2
Larvalökologie: die Raupe ernährt sich von Waldrebe (*Clematis*) und vom Großen Windröschen (*Anemone sylvestris*), nach CARTER & HARGREAVES (1987) auch vom Scharfen Hahnenfuß (*Ranunculus acris*). Biotopfremde Stücke wurden bisher nicht registriert. Vermutlich akzeptiert die Art im Untersuchungsgebiet die in den Gärten häufiger angepflanzten *Clematis*-Ziersträucher.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

BOARMIINAE

Arichanna melanaria (2 Individuen)

Distanzen: vermutlich 1-2, in Vorstößen bis 4
Larvalökologie: *A. melanaria* ist in Südbayern ein in (Hoch-)Mooren sehr lokal verbreiteter Spanner, der an das Vorhandensein von Moor-Heidelbeere (*Vaccinium uliginosum*), Sumpf-Porst (*Ledum palustre*) oder Moosbeere (*Oxycoccus palustris*) gebunden ist. Da keine dieser Pflanzen im Wasserwerk und vermutlich auch in der weiteren Umgebung vorkommt, handelt es sich bei den beiden in der gleichen Nacht gefangenen ♂♂ um ebenso überraschende wie interessante Funde! Die Exemplare waren beide stark abgeflogen und stammen vermutlich aus Biotopen in einer Entfernung von mindestens 20-30 km.
Verbreitungsstrategie: vermulich K-Stratege, 6. Gruppe; wahrscheinlich handelt es sich hier um ein Phänomen, dem wir schon bei den Schilfeulen begegnet sind, nämlich, daß auch orts- und habitattreue Arten bei einer Vernichtung des Lebensraumes oft weite Strecken zurücklegen können.
Sehr interessant ist in diesem Zusammenhang eine Publikation HACKERs (1981), der in Nordbayern bei *A. melanaria* einmal genau dieselbe Beobachtung machte und eine zurückgelegte Distanz von ca. 50 km vermutet.
Auch OSTHELDER (1925-1933) berichtet von einem Stück im (18 km entfernten) Eichenau, das "offensichtlich verweht" wurde. Auch hier beträgt die Entfernung zum nächstgelegenen von Osthelder genannten Fundort 20 km.

Abraxas grossulariata (1 Individuum)

Distanzen: vermutlich 1-2
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe; in Südbayern tritt diese Art nur sehr lokal und selten auf.

Calospilos sylvata

siehe Versetzexperiment (8.4.) und Rückschlüsse aus den Ortswiederfängen (8.5.)

1249* Individuen 10,1 % ♀- Rate

644** markiert 46** Wiederfänge

* tagsüber viele weitere Stücke

** 1989 343 markiert, 53 Wiederfänge

Wiederfang-Quote: sehr hoch; *C. sylvata* wurde nur 1988 und 1989 markiert, alle Wiederfänge erfolgten am Fangplatz "We". Hier wurde 1988 im 3-Tage-Rhythmus gefangen, die Ortswiederfang-Quote von 9,0 % und die mittlere Verweilzeit von 4,8 Tagen kennzeichnen *C. sylvata* als die ortstreueste aller im Rahmen dieser Arbeit markierten Arten. Nimmt man die in den Versetzexperimenten rückgefangenen Tiere hinzu, ergibt sich mit 4,6 Tagen ebenfalls eine sehr hohe mittlere Verweilzeit. Die längsten beobachteten Intervalle waren 3 Exemplare (♂♂♀) nach 12 Tagen.
Die beiden Geschlechter verhielten sich in den Experimenten ungefähr gleich.
Distanzen: 1-2
Larvalökologie: die Raupe lebt an einer Reihe von Laubbäumen. Im Offenland (HM) und schon 250 m außerhalb des Birkets (Moos 1985) konnten keine Stücke mehr nachgewiesen werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; abgesehen von den 1988 im Garten beobachteten Exemplaren wurden alle außerhalb des Mooses nachgewiesenen Stücke in maximal 200 m Entfernung zum Schloßkanalsystem gefunden. Diese Kanäle könnten unter Umständen als "Leitlinien" einer Verbreitung solch wenig mobiler Wald(rand)bewohner förderlich sein.

Lomaspilis marginata

357 Individuen 5,9 % ♀- Rate

236 markiert 5 Wiederfänge

Tab. 100: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Lomaspilis marginata*.

1987	SIEDLUNG		Garten		WALD		HALBTROKKENRASEN			"DACH. MOOS"	Σ
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	8	1	6	-	4	38	8	3	4	30	102
Σ zus.	1	-	-	2	-	10	1	1	4	1	20
♂♂	6	-	3	-	2	28	7	4	5	17	72
♀♀	2	-	1	-	1	2	-	-	1	1	8
Mark.	8	-	4	-	3	30	7	4	6	18	80
W.f.	-	-	-	-	-	-	-	-	-	-	-

1988	Garten		WALD Wasserwerk			HALBTROKKENRASEN			"DACH. MOOS"		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	4	4	51	31	43	5	3	5	16	71	233
Σ zus.	-	2	-	-	-	-	-	-	-	-	2
♂♂	3	2	36	25	30	3	2	2	12	36	151
♀♀	-	-	2	1	-	-	1	-	-	2	6
Mark.	3	2	38	26	29	3	3	2	12	38	156
W.f.	-	1	1	-	2	-	-	-	-	1	5

Wiederfang-Quote: durchschnittlich; ein Wiederfang (an WaS) ist durch den täglichen Betrieb der Lichtfalle bedingt. Die mittlere Verweildauer der anderen vier wiedergefangenen ♂♂ betrug niedrige 2,3 Tage.
Im Wasserwerk, wo die Wiederfang-Quote mit 3,2 % etwas über dem Durchschnitt liegt (bedingt durch die bessere Flächenabdeckung durch 3 Fallen), waren 2 der 3 rückgefangenen Tiere Ortswechsler, der eine über 100 m (WNw→WaN), der andere über 120 m (WNw→WNo).
Distanzen: 3
Larvalökologie: die Raupen sind an einigen Laubbaumarten zu finden; die regelmäßigen und vergleichsweise zahlreichen Nachweise an HM zeigen, daß der Zuflug aus dem Ruderal (150-300 m) für diese Art (♂♂ und ♀♀) eine völlig normale Distanz darstellt.
Populationsbiologie: im Untersuchungsgebiet vermutlich teilweise in 2 Generationen, die phänologisch jedoch nicht voneinander abzutrennen sind. Proterandrisch
Verbreitungsstrategie: r-Stratege, 3. Gruppe

Ligdia adustata (74 Individuen)

Distanzen: 2
Larvalökologie: monophag am Europäischen Pfaffenhütchen (*Euonymus europaea*); an einigen Standorten liegt die nächste Raupenfutterpflanze 100-200 m entfernt. Die Distanz von 1 km (Zuflug nach HM) liegt nicht im Bereich des trivial movement bzw. der Dispersionsaktivität dieser Art.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Bapta bimaculata (49 Individuen)

Distanzen: 1-2; die Häufigkeitsgradienten im Wasserwerk und im Garten könnten auf Barrieren gegen die freie Beweglichkeit hinweisen.
Larvalökologie: an einigen Laubbaumarten; im Offenland (HM) und an einigen Standorten mit tendenziellem Offenlandcharakter (SiM, SiN, WaN und HW) konnte die Art bisher nicht nachgewiesen werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Bapta temerata (196 Individuen)

Distanzen: 2 (-3?)
Larvalökologie: die Raupe ernährt sich von einer Reihe von Laubbaumarten; das an HM nachgewiesene ♂ stammt zumindest aus dem Ruderal (150-300 m).
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Cabera pusaria

232 Individuen 21,6 % ♀- Rate

72* markiert 1 Wiederfang * nur 1988

Wiederfang-Quote: niedrig! Unter "regulären" Bedingungen (fangfreie Nächte zur Ermöglichung der freien Durchmischung) konnte kein Tier wiedergefangen werden. Lediglich an WaS flog ein ♂ nach 1 Tag zum zweitenmal die Falle an; die Wiederfang-Quote liegt hier mit 4,0 % auf einem für die Methodik sehr niedrigen Niveau!
Distanzen: im Habitat 2-3, außerhalb 1-2; der Häufigkeitsgradient zwischen WaN und WNo (50 m) deutet wohl auf Barrieren gegen eine freie Dispersion hin.
Larvalökologie: die Raupen sind an Weide, Birke, Ulme Erle und Eiche zu finden; das HM-Stück (♂) stammt vermutlich aus dem Ruderal (150-300 m).
Populationsbiologie: im Untersuchungsgebiet mit einer partiellen 2. Generation
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Cabera exanthemata (273 Individuen)

Distanzen: 3
Larvalökologie: die Raupe ist an einigen Laubbaumarten zu finden; die HM-Stücke stammen wahrscheinlich aus dem Ruderal (150-300 m). Diese Distanzen liegen im absolut normalen Bereich der Dispersionsaktivitäten.
Populationsbiologie: bivoltin
Verbreitungsstrategie: r-Stratege, 2. Gruppe

Plagodis dolabraria (26 Individuen)

Distanzen: 2
Larvalökologie: ebenfalls an einigen Laubbaumarten; bisher konnten keine biotopfremden Tiere nachgewiesen werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Ellopia fasciaria (1 Individuum)

Distanzen: vermutlich 1-2
Larvalökologie: monophag an Kiefer (die Angaben beziehen sich bei dieser und der folgenden Art auf das Artverständnis wie es in FORSTER & WOHLFAHRT (1981) niedergelegt ist. Das an HW festgestellte Stück muß aus 150 m Entfernung (dem nächstgelegenen Standort ca. 2 m hoher Kiefern) ohne Sichtkontakt herbeigeflogen sein.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Ellopia prasinaria (6 Individuen)

Distanzen: 1-2
Larvalökologie: die Raupen ernähren sich von Fichte, Lärche und Weißtanne; bisher wurden alle Stücke in der Nähe der Raupenfutterpflanzen gefangen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Campaea margaritata (27 Individuen)

Distanzen: 1-2
Larvalökologie: die Raupe ist an einigen Laubbaumarten zu finden, biotopfremde Tiere konnten bisher nicht festgestellt werden. Der Häufigkeitsgradient 1988 im Garten auf nur 30 m Entfernung hängt vermutlich mit dem an SiN etwas weniger ausgeprägten Waldcharakter zusammen.
Populationsbiologie: bivoltin
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Ennomos autumnaria (4 Individuen)

Distanzen: vermutlich 2
Larvalökologie: relativ polyphag an Laubhölzern, bisher keine biotopfremden Tiere
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Deuteronomos alniaria (2 Individuen)

Distanzen: vermutlich 2
Larvalökologie: an einigen Laubbaumarten, das an HM gefangene ♂ stammt vermutlich aus dem Ruderal (150-300 m).
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Deuteronomos fuscantaria (2 Individuen)

Distanzen: vermutlich 2
Larvalökologie: die Raupen sind auf Gemeine Esche (*Fraxinus excelsior*) und Gemeinen Liguster (*Ligustrum vulgare*) spezialisiert. Die in manchen Jahren in den Garten zufliegenden Exemplare stammen aus mindestens 80 m Entfernung.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Deuteronomos erosaria (13 Individuen)

Distanzen: 2-3
Larvalökologie: Raupenfutterpflanzen sind vor allem Eiche, aber auch Birke, Linde und Rot-Buche. Das HM-Exemplar (1986) stammt also zumindest vom Flughafenrand (800-1000 m). Dies scheint in Jahren mit günstiger Bestandsentwicklung (z.B. 1986) ungefähr die Obergrenze der normalen Dispersionsaktivität darzustellen.
Populationsbiologie: im Garten fallen starke Häufigkeitsschwankungen auf, die vielleicht ein weiterer Hinweis dafür sein könnten, daß *D. erosaria* im Vergleich mit den anderen Arten der Gattung die dynamischste Strategie aufweist.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Selenia bilunaria (47 Individuen)

Distanzen: 2
Larvalökologie: nach den in KOCH (1984) genannten Raupenfutterpflanzen beurteilt, stammen die beiden HM-Stücke vom Ruderal (150-300 m).
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Selenia tetralunaria (45 Individuen)

Distanzen: 2
Larvalökologie: nach den in KOCH (1984) genannten Raupenfutterpflanzen beurteilt, stammt das HM-Stück vom Ruderal (150-300 m).
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Apeira syringaria (11 Individuen)

Distanzen: 1-2
Larvalökologie: alle bisher festgestellten Stücke wurden in unmittelbarer Nähe der in KOCH (1984) genannten Futterpflanzen gefangen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Gonodontis bidentata (31 Individuen)

Distanzen: 2
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Colotois pennaria

89 Individuen 7,1 % ♀- Rate

28 markiert 6 Wiederfänge

Wiederfang-Quote: durchschnittlich (?), Stichprobe noch zu klein. Alle Wiederfänge stammen aus dem Garten (WaS) 1988 bei täglichem Betrieb der Lichtfalle. 5 der 6 Rückfänge (♂♂, darunter zwei Zweitwiederfänge) erfolgten nach einem Intervall von 1 Tag und sind kein Hinweis auf eine mögliche Ortstreue der Imagines. Ein ♂ flog die Falle nach einem Intervall von 2 Tagen wieder an.
Die mittlere Verweilzeit liegt mit 1,8 Tagen auf einem relativ niedrigen Niveau (wie beispielsweise auch beim Wanderfalter *Noctua pronuba*).
Distanzen: im Habitat 2-3, außerhalb 1-2; die etwas plump wirkenden ♀♀ vielleicht auch nur 1-2; ihre schlechtere Flugtauglichkeit könnte auch in Zusammenhang mit einem nicht optimalen Anflugverhalten an das Licht stehen.
Larvalökologie: relativ polyphag an Laubbäumen; das polarisierte Häufigkeitsverhältnis im Garten 1988 (12/2 Individuen in den Parallelfängen) ist wohl als Hinweis darauf zu verstehen, daß zunehmender Offenlandcharakter (→ SiN) schon nach 30 m als Barriere gegen die Verbreitung zu wirken beginnt.
Verbreitungsstrategie: K-Stratege, 5. Gruppe; für die Verbreitung ist das Verhalten der ♀♀, nicht der ♂♂ relevant. Eine höhere Mobilität der ♂♂ kann jedoch zu einer besseren Gendurchmischung nützlich sein.

Crocallis elinguaria (104 Individuen)

Distanzen: 2
Larvalökologie: von den in KOCH (1984) genannten Raupenfutterpflanzen kommt in der näheren Umgebung des Fangplatzes HM (2 Exemplare 1986) nur der Weißdorn in Frage. Es gilt hierbei analog das bei *Allophyes oxyacanthae* (*Noctuidae*, *Cuculliinae*, S. 136) Gesagte. Der Häufigkeitsgradient im Garten 1988 ist vermutlich wie bei *Colotois pennaria* zu interpretieren.
Verbreitungsstrategie: K-Stratege, 5. Gruppe

Angerona prunaria (19 Individuen)

Distanzen: 2; 1989 wurde im Mallertshofer Holz (Hochwald) ein ♂ in der Abenddämmerung bei einem ziemlich geradlinigen Flug über 200 m beobachtet.
Larvalökologie: nach den in KOCH (1984) genannten Wirtspflanzen beurteilt, wurden im Untersuchungsgebiet bisher keine biotopfremden Tiere registriert.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Ourapteryx sambucaria (10 Individuen)

Distanzen: 1-2
Larvalökologie: nach den in KOCH (1984) genannten Wirtspflanzen beurteilt, wurden im Untersuchungsgebiet bisher keine biotopfremden Tiere registriert.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Opisthograptis luteolata (39 Individuen)

Distanzen: 2
Larvalökologie: die Raupe lebt an verschiedenen Laubgehölzen, v.a. an Sträuchern; die beiden im Offenland gefundenen Exemplare (♂♀) stammen wahrscheinlich aus dem Ruderal (150-300 m).
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Epione repandaria (31 Individuen)

Distanzen: 2-3
Larvalökologie: diese Art kann sich an Weide, Espe, Erle, Schlehe und Pappel entwickeln. Die Distanz von 150-300 m (Ruderal→HM) liegt im Bereich der normalen Dispersionsaktivität von *E. repandaria*.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Cepphis advenaria (23 Individuen)

Distanzen: 1-2
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Lozogramma chlorosata (1 Individuum)

Distanzen: vermutlich 1-2
Larvalökologie: die Raupen ernähren sich von Adlerfarn (*Pteridium aquilinum*), vielleicht auch von Gemeinen Wurmfarn (*Dryopteris filix-mas*). Das nachgewiesene Exemplar wurde in der Nähe der Futterpflanzen gefangen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Macaria notata (39 Individuen)

Distanzen: 2
Larvalökologie: an Birke, Erle, Sal-Weide und Eiche zu finden; das 1986 im Offenland gefundene Stück stammt vermutlich aus dem Ruderal (150-300 m)
Populationsbiologie: die 2. Generation dieser Art ist nur partiell ausgeprägt.
Verbreitungsstrategie: intermediärer Typ, 6. Gruppe

Macaria alternaria

279 Individuen	10,4 % ♀- Rate
77 markiert	1 Wiederfang

Wiederfang-Quote: durchschnittlich, an WaN erfolgte 1988 ein Ortswiederfang (♂) nach 2 Tagen.
Distanzen: 2
Larvalökologie: die Raupe frißt an Sal-Weide, Eiche, Erle, Schlehe und Traubenkirsche. Die beiden wahrscheinlich vom Ruderal (150-300 m) her zugeflogenen HM-Stücke (♂♂) zeigen, daß eine solche Distanz wohl innerhalb der Grenzen der normalen Dispersionsaktivität liegt.
Populationsbiologie: die 2. Generation dieser Art ist nur partiell ausgeprägt; proterandrisch
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Macaria signaria (31 Individuen)

Distanzen: 1-2
Larvalökologie: die Art ist an das Vorkommen von Gemeiner Fichte oder Heidekraut gebunden. Im Untersuchungsgebiet vor allem an Fichte, wie Raupenfunde bestätigten. Der bisher am weitesten von der Futterpflanze entfernte Nachweis ist ein ♂ an WNo (ca. 50 m)
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Macaria liturata

243 Individuen 29,9 % ♀- Rate

163 markiert 5 Wiederfänge

Tab. 101: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Macaria liturata.*

1987	SIEDLUNG SiS	SiM	Garten SiN	WaS	WALD WaM	WaN	HALBTROKKENRASEN HO	HM	HW	"DACHMOOS" Mb	Σ
Σ par.	-	2	19	11	7	15	25	-	1	-	80
Σ zus.	-	-	2	11	-	3	10	-	2	-	28
♂♂	-	1	11	9	4	8	14	-	1	-	48
♀♀	-	1	4	3	2	5	7	-	2	-	24
Mark.	-	2	15	11	6	13	21	-	3	-	71
W.f.	-	-	-	-	-	-	-	-	-	-	-

1988	Garten SiN	WaS	WALD Wasserwerk WaN	WNw	WNo	HALBTROKKENRASEN HO	HM	HW	"DACHMOOS" Au	We	Σ
Σ par.	5	26	25	28	10	9	-	2	1	-	106
Σ zus.	-	29	-	-	-	-	-	-	-	-	29
♂♂	-	25	12	19	6	5	-	1	1	-	69
♀♀	3	8	8	3	3	1	-	-	-	-	26
Mark.	2	33	19	22	9	6	-	1	-	-	92
W.f.	1	4	-	-	-	-	-	-	-	-	5

Wiederfang-Quote: niedrig! Alle Rückfänge erfolgten nach einem Intervall von nur 1 Tag und erklären sich also durch ein Festgehalten-Werden am Licht. Ein ♀ wechselte den Ort von WaS nach SiN, wo es tags darauf noch einmal gefangen wurde. Die mittlere Verweildauer liegt mit 1,3 Tagen sehr niedrig. Die ♀-Rate im Wiederfangergebnis entspricht ungefähr der der Erstfänge.
Distanzen: 2-3
Larvalökologie: auf Nadelhölzer spezialisiert; an HM wurden 1986 2 biotopfremde Stücke (♂♀) nachgewiesen, die mindestens 800-1000 m geflogen waren. Die Häufigkeitsgradienten im Wasserwerk und im Garten 1988 sprechen jedoch für Barrieren (Offenlandcharakter) gegen die Verbreitung dieser Art.
Populationsbiologie: bivoltin, 2. Generation nicht vollständig; proterandrisch
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; im Zusammenhang mit der günstigen Bestandsentwicklung fast aller an Kiefern lebenden Arten 1986 erfolgte auch bei *M. liturata* ein "Verbreitungsschub", der sich in Vorstöße auf das Offenland hinaus bemerkbar machte. In normalen Jahren liegt dagegen die Obergrenze der Dispersionsaktivität über biotopfremdes Gebiet niedriger.

Chiasmia clathrata

siehe verringerte Fallendistanzen (8.3.)

157 Individuen 3,5 % ♀- Rate

112 markiert 11 Wiederfänge

Tab. 102: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Chiasmia clathrata.*

1987 1. Gen.	SIEDLUNG SiS	SiM	Garten SiN	WaS	WALD WaM	WaN	HALBTROKKENRASEN HO	HM	HW	"DACHMOOS" Mb	Σ
Σ par.	-	-	-	-	4	7	16	1	2	1	31
Σ zus.	-	-	-	-	-	3	-	-	-	-	3
♂♂	-	-	-	-	4	7	10	1	1	-	23
♀♀	-	-	-	-	-	-	1	-	-	-	1
Mark.	-	-	-	-	4	7	11	1	1	-	24
W.f.	-	-	-	-	3	-	-	-	-	-	3

1987 2. Gen.	SIEDLUNG SiS	SiM	Garten SiN	WaS	WALD WaM	WaN	HALBTROKKENRASEN HO	HM	HW	"DACHMOOS" Mb	Σ
Σ par.	1	-	-	1	18	9	7	-	7	1	44
Σ zus.	-	-	1	-	-	1	1	-	2	-	5
♂♂	1	-	1	1	15	6	5	-	4	-	33
♀♀	-	-	-	-	-	1	-	-	-	1	2
Mark.	1	-	1	1	15	7	5	-	4	1	35
W.f.	-	-	-	-	-	-	-	-	-	-	-

1988 1. Gen.	Garten SiN	WaS	WALD Wasserwerk WaN	WNw	WNo	HALBTROKKENRASEN HO	HM	HW	"DACHMOOS" Au	We	Σ
Σ par.	-	-	5	2	19	5	1	3	1	-	36
Σ zus.	-	-	-	-	-	-	-	-	-	-	-
♂♂	-	-	3	1	16	3	1	2	-	-	26
♀♀	-	-	-	-	-	-	-	-	-	-	-
Mark.	-	-	3	1	15	3	1	2	-	-	25
W.f.	-	-	1*	-	4	-	-	-	-	-	5

* tags

1988 2. Gen.	Garten SiN	WaS	WALD Wasserwerk WaN	WNw	WNo	HALBTROKKENRASEN HO	HM	HW	"DACHMOOS" Au	We	Σ
Σ par.	-	2	6	3	15	7	-	5	-	1	37
Σ zus.	-	1	-	-	-	-	-	-	-	-	1
♂♂	-	2	5	3	10	6	-	3	-	-	27
♀♀	-	-	-	-	1	-	-	-	-	-	1
Mark.	-	2	5	2	10	6	-	3	-	-	28
W.f.	-	-	1	1	1	-	-	-	-	-	3

Wiederfang-Quote: hoch! Abgesehen von den bereits diskutierten Wiederfängen im Wasserwerk ereigneten sich 1987 im Berglwald (WaM) zwei Erstwiederfänge (♂♂) nach 2 bzw. 5 Tagen und ein Zweitwiederfang nach insgesamt 8 Tagen. Die Verweilzeiten liegen also auch hier sehr hoch.
Die Wiederfang-Quoten und Verweilzeiten der 2. Generation liegen grundsätzlich niedriger als die der 1. Generation, was vermutlich an einer höheren Mobilität liegt. Es scheinen auch die Geländestrukturen eine Rolle zu spielen: Abgeschlossene, gut kompartimentierte Areale (z.B. WaM, Wasserwerk) begünstigen im Vergleich zu anderen Standorten (z.B. HO und HW) die Ortstreue, was sich in deutlichen Unterschieden der Wiederfang-Quote niederschlägt.

Distanzen: 1. Generation 1-2, 2. Generation 2 (-3?); der Häufigkeitsgradient im Wasserwerk 1988 entsprach den Beobachtungen, die tagsüber gemacht werden konnten. Die in Lebend-Lichtfallenfängen ermittelten relativen Häufigkeiten spiegeln also durchaus die tatsächlichen Verhältnisse in einer ausreichenden Weise wieder. Es scheint also Barrieren gegen die freie Verbreitung von *C. clathrata* zu geben.
Ein weiterer Hinweis in dieser Richtung ist die (am Tag gemachte) Beobachtung, daß Exemplare, die an Biotopgrenzen gelangen, bevorzugt ein Richtungsänderungs-Verhalten zeigen. Hierbei sind Erkennungsmechanismen zu postulieren.
Populationsbiologie: bivoltin
Verbreitungsstrategie: K-Stratege, 4. Gruppe; zur Strategie gehört allerdings auch die in der 2. Generation etwas erhöhte Verbreitungspotenz. So konnte *C. clathrata* im Garten bisher ausnahmslos erst in der zweiten Generation nachgewiesen werden (in 7 Jahren), was offensichtlich auf zufliegende Exemplare zurückzuführen ist. Man könnte fast von einem "obligatorischen Turnover" sprechen, wenn man die Generationen separat betrachtet.

Itame wauaria (65 Individuen)

Distanzen: 1-2
Larvalökologie: die Raupen sind auf Stachelbeere und Rote Johannisbeere spezialisiert; die beiden an SiS und WNo festgestellten Stücke stammen mindestens aus 50 m Entfernung. Der starke Häufigkeitsgradient im Garten deutet auf geringe Dispersionsaktivitäten hin (in einer Entfernung von 25 m zu WaS existieren größere Johannisbeer-Bestände).
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Itame fulvaria (2 Individuen)

Distanzen: im Untersuchungsgebiet vermutlich 2
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe; in anderen Gebieten, wo die Raupen nach KOCH (1984) in Heidelbeerwäldern gelegentlich Kahlfraß erzeugen, verfolgt *I. fulvaria* unter Umständen eine andere Strategie.

Theria rupicapraria (7 Individuen)

Wiederfang-Quote: hoch, Stichprobe noch zu klein! Von den fünf 1988 im Wasserwerk markierten ♂♂ konnte eines am Fallenstandort WaN nach 2 Tagen wiedergefangen werden.
Distanzen: ♂♂ 1 (-2?); ♀♀ (flugunfähig): 1
Larvalökologie: an Schlehe und Weißdorn; bisher konnten keine biotopfremden Tiere nachgewiesen werden, die hin und wieder im Garten auftauchenden Stücke stammen wahrscheinlich von den ca. 10 m (WaS) bis 30 m (SiN) entfernten Schlehen- und Weißdornbüschen.
Verbreitungsstrategie: typischer K-Stratege, 6. Gruppe; siehe Bemerkungen zu *Alsophila aescularia* und *Operophthera brumata*.

Erannis bajaria (6 Individuen)

Wiederfang-Quote: 1988 wurden im Garten 2 ♂♂ markiert, eines (WaS) flog am darauffolgenden Tag zum zweitenmal in die Falle.
Distanzen: vermutlich 1-2; die stummelflügeligen ♀♀ nur 1
Populationsbiologie: diese Art ist in Südbayern wie im Untersuchungsgebiet offensichtlich nur äußerst lokal verbreitet, für Schleißheim lagen aber schon am Anfang dieses Jahrhunderts Nachweise von *E. bajaria* vor. Dies spricht für eine sehr hohe Stabilität der Populationen dieser Art.
Verbreitungsstrategie: typischer K-Stratege, 6. Gruppe; siehe Bemerkungen zu *Alsophila aescularia* und *Operophthera brumata*.

Erannis leucophaearia (24 Individuen)

24 Individuen	0 %* ♀- Rate
20 markiert	kein Wiederfang

* die ♀♀ sind flugunfähig

Wiederfang-Quote: niedrig (?), Stichprobe noch zu klein; an HO, wo 1987 14 Individuen markiert wurden, erfolte der Lichtfang zur Flugzeit nur wöchentlich.
Distanzen: ♂♂ 2, die stummelflügeligen ♀♀ nur 1
Larvalökologie: die Raupen ernähren sich v.a. von Eiche, manchmal auch von Espe oder Obstbäumen; an allen Stellen, wo *E. leucophaearia* bisher festgestellt wurde, befinden sich in der Nähe potentielle Raupenfutterpflnzen.
Verbreitungsstrategie: K-Stratege, 6. Gruppe; siehe Bemerkungen zu *Alsophila aescularia* und *Operophthera brumata*.

Erannis aurantiaria (9 Individuen)

Distanzen: ♂♂ 1-2, die stummelflügeligen ♀♀ nur 1
Larvalökologie: an Laubgehölz, bisher keine biotopfremden Tiere
Verbreitungsstrategie: K-Stratege, 6. Gruppe; siehe Bemerkungen zu *Alsophila aescularia* und *Operophthera brumata.*

Erannis marginaria

84 Individuen   0 %* ♀- Rate

74 markiert   3 Wiederfänge

* die stummelflügeligen ♀♀ sind flugunfähig; 1988 wurden im Garten 2 ♀♀ beobachtet, eines davon erklomm eine Mauer und gelangte so in unmittelbare Nähe der in dieser Nacht eingeschalteten UV-Röhre.

Wiederfang-Quote: niedrig; 1987 erfolgten 2 Wiederfänge bei täglichem Betrieb der Falle nach einem Intevall von je 1 Tag; eines der beiden Tiere wechselte dabei den Standort (WaS→SiN = 30 m). 1988 wurde im Garten (WaS) ein Exemplar nach 2 Tagen rückgefangen. Es ergibt sich eine sehr niedrige mittlere Verweildauer von 1,3 Tagen.
Distanzen: ♂♂ 2-3; ♀♀ 1
Larvalökologie: an Laubbäumen, bisher keine biotopfremden Tiere
Verbreitungsstrategie: K-Stratege, 6. Gruppe (was die ♀♀ betrifft); die ♂♂ sorgen durch ihre erhöhte Mobilität für eine gute Durchmischung des Erbmaterials. Siehe Bemerkungen zu *Alsophila aescularia* und *Operophthera brumata.*

Erannis defoliaria

54 Individuen   0 %* ♀- Rate

22 markiert   6 Wiederfänge

* sie stummelflügeligen ♀♀ sind flugunfähig

Wiederfang-Quote: hoch, Stichprobe noch zu klein; 4 Wiederfänge beziehen sich auf den Garten (SiN, WaS) 1988 bei Intervallen von nur 1 Tag, 2 andere erfolgten nach einer fangfreien Nacht, also einem 2-Tage-Intervall. Es ereigneten sich 3 Mehrfachwiederfänge, es errechnet sich eine mittlere Verweildauer von 3,3 Tagen, einem vergleichsweise hohen Wert.
Distanzen: ♂♂ 1-2; ♀♀ 1
Larvalökologie: an Laubbäumen, bisher keine biotopfremden Tiere
Verbreitungsstrategie: K-Stratege, 6. Gruppe; siehe Bemerkungen zu *Alsophila aescularia* und *Operophthera brumata.*

Phigalia pedaria

45 Individuen   0 %* ♀- Rate

43 markiert   2 Wiederfänge

* die ♀♀ sind flugunfähig (nur sehr rudimentäre Flügelstummel)

Wiederfang-Quote: hoch, statistisch noch nicht gut abgesichert; zwei 1987 markierte Falter (SiN, HW) wurden nach je 2 Tagen wiedergefangen.
Distanzen: ♂♂ 2, ♀♀ 1
Larvalökologie: an verschiedenen Laubhölzern, bisher keine biotopfremden Tiere
Verbreitungsstrategie: K-Stratege, 6. Gruppe; siehe Bemerkungen zu *Alsophila aescularia* und *Operophthera brumata.*

Apocheima hispidiaria (1 Individuum)

Distanzen: vermutlich 1-2; ♀♀ 1
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe; die ♀♀ sind auch bei dieser Art wegen der sehr rudimentär ausgebildeten Flügelstummel flugunfähig. Siehe Bemerkungen zu *Alsophila aescularia* und *Operophthera brumata.*

Lycia hirtaria (52 Individuen)

Distanzen: 2
Larvalökologie: an verschiedenen Laubbäumen, bisher keine biotopfremden Tiere
Verbreitungsstrategie: K-Stratege, 6. Gruppe; die ♀♀ sind bei dieser Art flugfähig.

Biston strataria (7 Individuen)

Distanzen: 2-3
Larvalökologie: an verschiedenen Laubbäumen; die in 2 Jahren im Offenland (HM) beobachteten Exemplare stammen aus mindestens 150-300 m Entfernung (Ruderal). Für *B. strataria* scheint Offenlandcharakter keine so große Barriere gegen die Verbreitung darzustellen wie für viele andere Geometriden.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Biston betularia

107 Individuen 0 %* ♀- Rate

44 markiert 3 Wiederfänge

* von den 44 markierten Exemplaren. Die ♀♀ wirken - besonders im fertilen Zustand - recht schwerfällig, was vermutlich das (An-)Flugverhalten behindert. Im Birket 1987 wurden jedoch 3 ♀♀ gefangen, und es war auch eine Kopula an der Lichtfalle zu beobachten. Auch 1989 flogen wieder mehrere ♀♀ ans Licht.

Wiederfang-Quote: durchschnittlich; zwei schon in der nächsten Nacht rückgefangene Tiere im Garten 1988 erklären sich als methodisch bedingt (Festgehalten-Werden durch die Lichtwirkung). Eines dieser beiden Wiederfänge war ein Ortswechsler (SiN→ WaS = 30 m).
Im Wasserwerk (WaN) konnte ein ♂ nach 2 Tagen wiedergefangen werden.
Distanzen: 2
Larvalökologie: nach den in KOCH (1984) genannten Wirtspflanzen beurteilt, stammen die 4 nach HM zugeflogenen Exemplare mindestens aus dem Ruderal (150-300 m). Der starke Häufigkeitsabfall im Wasserwerk (WaN→ WNo) schon in 50 m Entfernung läßt auf Barrieren gegen die freie Mobilität dieser Art schließen.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Peribatodes rhomboidaria

siehe Fernwiederfänge (8.2.) und Versetzexperiment (8.4.)

520 Individuen 9,4 % ♀- Rate

362 markiert 57 Wiederfänge

Tab. 103: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Peribatodes rhomboidaria*; die Art wurde nur 1988 markiert.

1988	Garten		WALD Wasserwerk			HALBTROKKENRASEN			*DACH-MOOS*		Σ
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	31	154	25	9	15	22	-	5	3	-	264
Σ zus.	-	174	-	-	-	-	-	-	-	-	174
♂♂	23	267	17	2	11	16	-	2	1	-	339
♀♀	5	21	3	3	-	-	-	-	-	-	32
Mark.	23	288	19	4	10	15	-	2	1	-	362
W.f.	5	48	-	1	2	1	-	-	-	-	57

Wiederfang-Quote: hoch; in der im Garten vergleichsweise niedrig liegenden mittleren Verweildauer von 1,8 Tagen (wie beispielsweise *Noctua pronuba*) kommt das stark ausgeprägte Umherschweifen dieser Art in der näheren Umgebung zum Ausdruck.
Im Wasserwerk liegt die Wiederfang-Quote (9,1 %) bei einer relativ kurzen Verweildauer von 2,3 Tagen auf sehr hohem Niveau. Hier ist es durch die Methodik (verringerte Fallendistanzen) bei einer besseren Flächenabdeckung gelungen, etwas nachzuweisen, was mit Einzelfallen nicht möglich ist: ein Verbleiben in der näheren Umgebung, aber außerhalb der Reichweite der Lichtfalle. Zwei der drei Wiederfänge waren nämlich Ortswechsler: WaN→ WNw = 100 m und WaN→ WNo = 50 m. Die ♀♀ sind im Wiederfangergebnis deutlich unterrepräsentiert (siehe 8.4.).
Distanzen: 2-3; der Häufigkeitsgradient im Garten auf nur 30 m Distanz spricht für Barrieren gegen die freie Mobilität dieser Art. Diese Hindernisse (z.B. Häuserzeile, Biotopstruktur) wurden bereits in den Ergebnissen des Versetzexperimentes diskutiert.
Larvalökologie: relativ polyphag
Populationsbiologie: proterandrisch
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe; nach LATTIN (1967) unternahm *P. rhomboidaria* in diesem Jahrhundert Arealausweitungen in Richtung Nordwesten. Interessant ist in diesem Zusammenhang der Fernwiederfang nach nur einem Tag (siehe 8.2.).

Peribatodes secundaria (238 Individuen)

Distanzen: 2, manchmal bis 3
Larvalökologie: an das Vorhandensein von Nadelbäumen gebunden; das an HM 1988 festgestellte Stück stammt aus mindestens 800-1000 m Entfernung (Flughafenrand). Diese Distanz wird jedoch nur ausnahmsweise bewältigt.
Im Garten und im Wasserwerk sind entsprechend der Verteilung der Futterpflanzen deutliche Häufigkeitsgradienten feststellbar, die für biotopstrukturbedingte Barrieren gegen die freie Beweglichkeit sprechen.
Verbreitungsstrategie: K-Stratege, 5. Gruppe

Cleora cinctaria (3 Individuen)

Distanzen: vermutlich 2-3
Verbreitungsstrategie: vermutlich intermediärer Typ, 5. Gruppe

Deileptenia ribeata (325 Individuen)

Distanzen: 2
Larvalökologie: an einer Reihe von Nadel- und Laubbaumarten, v.a. an Gemeiner Fichte; die 3 im Offenland (HM) nachgewiesenen Falter (♂♂) hatten sich jedoch vermutlich im Ruderal (150-300 m entfernt) an Sal-Weide entwickelt.
Die im Wasserwerk und im Garten erkennbaren deutlichen Häufigkeitsgradienten entsprechen der Verteilung der "Hauptfutterpflanze" Fichte und deuten auf Barrieren gegen die freie Mobilität hin.
Populationsbiologie: im Garten fallen die starken Häufigkeitsschwankungen von Jahr zu Jahr auf.
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Alcis repandata

siehe Fernwiederfänge (8.2.), verringerte Fallendistanzen (8.3.) und Versetzexperiment (8.4.)

1371 Individuen   16,0 % ♀- Rate

1127 markiert   69 Wiederfänge

Tab. 104: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Alcis repandata.*

1987	SIEDLUNG				WALD		HALBTROKKENRASEN			"DACHMOOS"	Σ
			Garten								
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	7	1	14	39	15	33	20	-	1	9	139
Σ zus.	-	-	2	79	-	8	9	-	1	-	99
♂♂	2	-	10	69	7	20	19	-	-	3	130
♀♀	3	1	2	16	4	12	6	-	-	1	45
Mark.	5	1	12	78	11	30	24	-	-	4	165
W.f.	-	-	-	1	-	-	-	-	1	-	2

1988	WALD					HALBTROKKENRASEN			"DACHMOOS"		Σ
	Garten		Wasserwerk								
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	18	310	71	157	132	59	1	4	11	9	772
Σ zus.	-	361	-	-	-	-	-	-	-	-	361
♂♂	12	541	46	87	94	39	1	4	8	7	839
♀♀	2	53	18	41	18	7	-	-	-	-	139
Mark.	13	590	60	126	108	46	1	3	8	7	962
W.f.	1	57	1	3	5	-	-	-	-	-	67

Wiederfang-Quote: durchschnittlich, im Wasserwerk relativ hoch, dasselbe Bild zeigt sich auch bei den mittleren Verweilzeiten.
Die ♀♀ sind im Wiederfangergebnis unterrepräsentiert (siehe 8.4.).
Distanzen: im Habitat 2-3, außerhalb 2; die Häufigkeitsgradienten im Wasserwerk und im Garten deuten auf Barrieren gegen die freie Mobilität dieser Art hin.
Larvalökologie: vergleichsweise polyphag; das an HM gefangene ♂ ist jedoch als biotopfremd zu bezeichnen und stammt zumindest aus dem Ruderal (150-300 m).
Populationsbiologie: relativ wenig proterandrisch; im Wasserwerk fallen starke Unterschiede in den ♀-Raten (WNw: 32,0 % - WNo: 16,1 %) auf einer Distanz von 120 m auf.
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Boarmia roboraria (49 Individuen)

Distanzen: 1-2
Larvalökologie: die Raupe kann an einigen Laubbäumen gefunden werden, bisher konnten keine biotopfremden Tiere nachgewiesen werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Serraca punctinalis (251 Individuen)

Distanzen: 2 (-3 ?); im Wasserwerk und im Garten waren auffällige Häufigkeitsgradienten zu beobachten.
Larvalökologie: nach den in KOCH (1984) genannten Raupenfutterpflanzen beurteilt, stammt das HM-Stück (1987, ♂) zumindest aus dem Ruderal (150-300 m).
Verbreitungsstrategie: K-Stratege, 5. Gruppe

Ectropis bistortata

340 Individuen 5,5 % ♀- Rate

247 markiert 14 Wiederfänge

Tab. 105: Fangergebnisse, Geschlechterverteilung und Markierungsergebnisse von *Ectropis bistortata*.

1987	SIEDLUNG		WALD				HALBTROK-KENRASEN			"DACH. MOOS"	Σ
			Garten								
	SiS	SiM	SiN	WaS	WaM	WaN	HO	HM	HW	Mb	
Σ par.	4	3	24	28	12	10	7	-	1	15	104
Σ zus.	-	-	13	33	-	-	2	-	-	-	48
♂♂	3	1	25	38	10	9	3	-	-	10	99
♀♀	-	1	5	1	1	-	-	-	-	-	8
Mark.	3	2	28	39	9	9	3	-	-	10	103
W.f.	-	-	-	-	1	-	-	-	-	-	1

1988	WALD					HALBTROK-KENRASEN			"DACH. MOOS"		Σ
	Garten		Wasserwerk								
	SiN	WaS	WaN	WNw	WNo	HO	HM	HW	Au	We	
Σ par.	13	54	8	13	11	14	-	2	13	9	13
Σ zus.	-	51	-	-	-	-	-	-	-	-	5
♂♂	11	79	7	12	10	11	-	1	8	3	14
♀♀	-	1	1	1	1	1	-	-	1	-	
Mark.	10	80	7	13	10	12	-	-	9	3	14
W.f.	1	11	-	-	1	-	-	-	-	-	1

Wiederfang-Quote: durchschnittlich; ähnlich wie bei *Calocalpe cervinalis* und bei *Chiasmia clathrata* könnten hier Geländestrukturen eine Rolle spielen: Am Standort WaM wurde ein ♂ nach einem relativ langen Intervall von 5 Tagen wiedergefangen (bei nur 9 Markierungen).
Im Wasserwerk konnte ein Ortswechsler (WNw→WNo = 120 m) nach 2 Tagen nachgewiesen werden.
Im Garten erfolgte in der 1. Generation ein Wiederfang (♂) nach zwei Tagen (bei einer dazwischenliegenden fangfreien Nacht). In der 2. Generation (täglicher Fang, WaS) war bei einer Wiederfang-Quote von 16,7 % eine (niedrige) mittlere Verweildauer von 1,3 Tagen festzustellen. Ein Tier wechselte von WaS nach SiN (30 m). Es fällt das Fehlen von Zweitwiederfängen auf.
Die beiden Generationen zeigen in den Markierungsexperimenten ungefähr gleiche Ergebnisse.
Distanzen: 2-3; das polarisierte Häufigkeitsmuster im Garten (und vielleicht im Wasserwerk) deuten auf Barrieren gegen die freie Mobilität dieser Art hin. Diese Barrieren sind sind in der fehlenden Deckung und im dadurch steigenden Feinddruck bei zunehmendem Offenlandcharakter zu vermuten.
Larvalökologie: recht polyphag; die beiden 1986 im Offenland (HM) gefangenen ♂♂ sind jedoch hier nur Gäste und stammen zumindest aus dem Ruderal (150-300 m entfernt).
Populationsbiologie: bivoltin, sehr partiell sogar eine 3. Generation
Verbreitungsstrategie: intermediärer Typ, 3. Gruppe

Ectropis extersaria (6 Individuen)

Distanzen: vermutlich 1-2
Larvalökologie: die Raupe ernährt sich von einigen Laubbaumarten; bisher konnten noch keine biotopfremden Tiere nachgewiesen werden.
Verbreitungsstrategie: vermutlich K-Stratege, 6. Gruppe

Aethalura punctulata (20 Individuen)

Distanzen: 1-2
Larvalökologie: diese Art ist auf Erle und Birke spezialisiert; bisher konnten keine biotopfremden Tiere festgestellt werden. Am Rand des Franzosenhölzls wurden 1989 an einer Birke 8 Exemplare gefangen, 45 m davon entfernt jedoch keines mehr.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

Ematurga atomaria (26 Individuen + tagsüber sehr viele weitere Exemplare)

Distanzen: 2 (-3?); im Kern des Siedlungsgebietes sowie im Garten wurde diese sonst recht häufige Art bisher nicht registriert; die Distanz von ca. 1 km (Zuflug in den Ort) scheint vielleicht nicht im Bereich der normalen Dispersionsaktivität zu liegen.
Populationsbiologie: bivoltin
Verbreitungsstrategie: intermediärer Typ, 5. Gruppe

Bupalus piniaria

89 Individuen 17,6 % ♀- Rate

82 markiert 2 Wiederfänge

Wiederfang-Quote: etwas überdurchschnittlich; im Garten (SiN) wurde 1987 ein ♂ nach 3 Tagen, im Wasserwerk 1988 (WNw) ein ♂ nach 4 Tagen wiedergefangen. Im Wasserwerk waren alle Fangplätze mindestens 20 m von der nächsten Futterpflanze entfernt, vielleicht wäre bei einem Fang unmittelbar an den Orten der Larvalentwicklung eine höhere Wiederfang-Quote zu erwarten.
Distanzen: 1-2, bei Kalamitäten vermutlich auch 3
Larvalökologie: die als Schädling gefürchtete Raupe ernährt sich von Wald-Kiefer, selten auch von anderen Nadelbäumen. Im reinen Offenland konnten bisher keine Exemplare beobachtet werden; bei den 4 an HW nachgewiesenen Stücken (♂♂♀♀) erscheint es fraglich, ob die Entwicklung an den in der unmittelbaren Nähe wachsenden kleinen Fichten stattfand, vermutlich waren sie eher von den 3 in ca. 100 m Entfernung stehenden 1-2 m hohen Kiefern oder von den 500 m entfernten größeren Kiefernbeständen herbeigeflogen.
Im Wasserwerk waren in Entfernungen von 20, 30 und 75 m zur nächsten Kiefer (WNw, WNo und WaN) ein Häufigkeitsabfall von 22 auf 9 und schließlich auf 3 Individuen festzustellen.
Populationsbiologie: proterandrisch
Verbreitungsstrategie: r-Stratege, 5. Gruppe; in mehrjährigen Rhythmen können starke Gradationen stattfinden (Odum & Reichholf, 1980). *B. piniaria* wird dann bedeutend mobiler sein, als es in den beiden Untersuchungsjahren in Oberschleißheim zu beobachten war.

Siona lineata (30 Individuen + tagsüber viele weitere Exemplare)

Distanzen: 2; die Distanz von 1 km über biotopfremdes Gebiet wird im Normalfall nicht bewältigt: So konnte *S. lineata* im Siedlungsgebiet bisher nicht beobachtet werden.
Verbreitungsstrategie: K-Stratege, 6. Gruppe

9.3. AUSWERTUNG

9.3.1. r-K-Kontinuum

92 Arten (19 %) sind als r-Stratege, 183 (37 %) als intermediärer Typ, und 220 (44 %) als K-Stratege zu bezeichnen. Diese Prozentsätze sind als relative Angaben innerhalb des Artenspektrums zu verstehen (ODUM & REICHHOLF, 1980). Insekten können innerhalb des Tierreiches insgesamt als eher r-selektiert aufgefaßt werden (PIANKA, 1970).
Die Eulenfalter (*Noctuidae*) sind vorwiegend r-Strategen (27 %) und intermediär (47 %), während bei den Spannern (*Geometridae*) die K-Strategen mit 68 % überwiegen.

9.3.2. Flugdistanzen

Aus Abbildung 46 wird ersichtlich, daß bei einem Großteil des Artenspektrums Flugdistanzen von 1 km normalerweise nicht überschritten werden. Die Bemerkung HEYDEMANNs (1981), wonach nachtaktive Schmetterlinge "5-10 km große Fremdbiotope" überfliegen, "um einen neuen Bestand dieses Biotoptyps aufzusuchen" darf daher nicht pauschalisiert verstanden werden. Zumindest in unregelmäßigen Zeitabschnitten wird die Entfernung von 1 km jedoch von allen Arten ab der 2. Gruppe in Einzelexemplaren bewältigt.
Es zeigt sich auch, daß die Betrachtung eines einzelnen Lichtfallen-Standortes eine hohe Dynamik offenlegen sollte: Da die Wirkung der Falle im Gebiet jenseits eines Radius' von ca. 50 m nur mehr unwesentlich zum Tragen kommt (siehe 8.4.), sind 98 % des Artenspektrums als Arten gekennzeichnet, bei denen eine Abwanderung aus dem Einzugsbereich ein normaler Vorgang ist. Ein größerer Teil der "Gruppe 1" sind zudem Arten, deren ♀♀ flügellos sind, und deren ♂♂ ebenfalls aus dem Einzugsbereich abfliegen können.

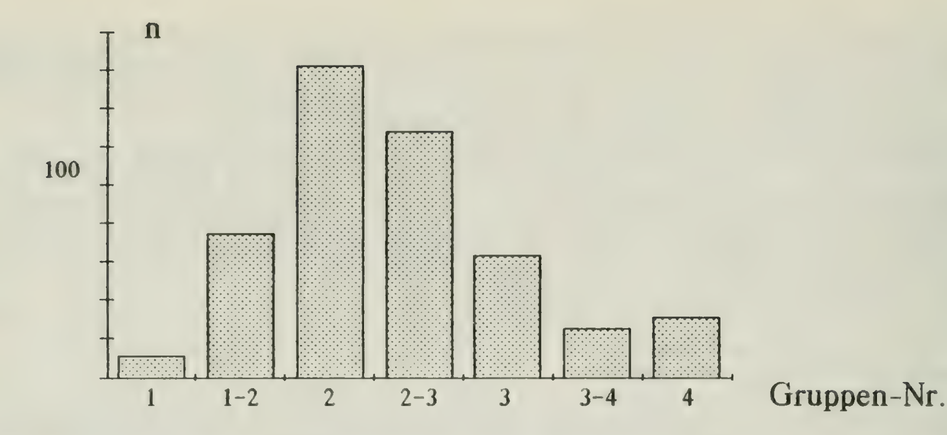


Abb. 46: Anteile des Artenspektrums an den verschiedenen Gruppen der Flugdistanzen (nach SCOTT, 1975; Erklärung siehe 9.1.).
Number of species belonging to the different groups of flight distances (SCOTT, 1975).

9.3.3. Ökotypen

Erwartungsgemäß ist unter den Ubiquisten der Anteil der r-Strategen mit 60 % am höchsten. Da sowohl bei der Einteilung in die verschiedenen Ökotypen als auch bei der Zuteilung einer Strategie teilweise die Verbreitungsmuster im Untersuchungsgebiet miteinflossen ist eine solche Beurteilung jedoch streng genommen nicht zulässig.
Nimmt man die Gruppennummern nach SCOTT (l.c., siehe 9.1. und 9.3.2.) als arithmetische Werte und addiert so die Zahlen für alle Vertreter eines jeden Ökotyps auf, so ergibt sich nach einer Division durch die Artenzahl n ein Maß für durchschnittlich zurückgelegte Distanzen:

Tab. 106: Gruppenmittel (mittlere Flugdistanzen nach SCOTT, 1975; siehe 9.1.) der verschiedenen Ökotyp-Vertreter (Bezeichnung siehe 4.3.).
Mean of the group values (flight distances after SCOTT, 1975; see 9.1.) of various ecotypes (see 4.3.).

ÖKOTYP *ecotype*	Ub	mGr	Agr	Xe	Geb	W	Hy	Gesamt
GRUPPENMITTEL *mean of group values*	3,0	2,7	3,2	2,7	2,2	2,0	2,2	2,37

Für die Ubiquisten und die Arten des Ackerlandes ergeben sich hohe Werte, zurückgelegte Distanzen von einem Kilometer und mehr sind die Regel. Diese Entfernungen werden dagegen von den Arten der Wälder, der Waldränder, der Gebüsche und der hygrophilen Fauna normalerweise nicht bewältigt.
Differenziert man noch etwas genauer und betrachtet die als "Ruderalarten" bezeichneten Arten separat, so zeigt sich im Gegensatz zu den "Geb"-Arten ein hoher Wert von 2,75, was mit dem ephemeren Charakter dieses Lebensraumes zusammenhängt: Die Spezialisierung auf Habitate in frühen Sukzessionsstadien führte bei deren Bewohnern im Lauf der Evolution zu tendenziell erweiterten Aktionsradien, da für diese Arten ein

Aufsuchen neuer Lebensräume öfter nötig wird. Auch GLAZIER (1986) postuliert für weit umherfliegende Arten, daß sie "öfter in gestörten, ephemeren oder stark saisonalen Habitaten gefunden werden".
Allgemein betrachtet zeigen sich bei einer Beurteilung durch das Kriterium der potentiellen Flugdistanzen zwei unterschiedliche Typen: Die Offenlandfauna einschließlich der xerothermophilen sowie der für Ruderalien typischen Arten ist als tendenziell expansiv einzustufen, während alle anderen Gruppen verstärkt ortstreue Arten beinhalten. Für einige "charakteristische Heidefalter" veranschlagt auch WARNECKE (1952) eine Mindest-Flugdistanz (Luftlinie) von 4-5 km ins Stadtgebiet von Hamburg hinein.

9.3.4. Arten extremer Jahreszeiten

Die Arten der Frühlingsmonate (Flugzeitschwerpunkte bis April) sowie die Herbst- und Spätherbstarten fallen, nach den Flugdistanzen und ihren Strategien beurteilt, nicht wesentlich aus dem Rahmen. Auffallend ist, v.a. im Spätherbst, die hohe Anzahl an Arten mit flügellosen Weibchen, was meist mit einer K-Strategie verknüpft ist, obwohl des öfteren eine gewisse Kompensation dieses Verbreitungshindernisses durch "bewegliche Raupenstadien" (Flugfäden) erreicht wird.
Die Arten der Gattungen *Orthosia* (Frühflieger) und *Agrochola* (Flugzeiten im Herbst) zeigen nicht nur Konvergenzerscheinungen bezüglich der äußeren Merkmale und der Flugzeit unter extremeren Bedingungen, sondern sind auch durch die vergleichsweise hohe Mobilität innerhalb der Arten gekennzeichnet, deren Raupen auf Bäumen leben.
Zur Deckung des Energiebedarfs sind unter solchen extremen Bedingungen höhere Aktivitäten im Sinne des trivial movement nötig, um zu den oft vereinzelten Nektarquellen zu gelangen.
Die Indices der Flugdistanzen liegen bei 2,7 (*Orthosia*) und 2,4 (*Agrochola*).

9.3.5. Proterandrie

Ein proterandrisches Erscheinungsbild ist als Antwort auf die Notwendigkeit zu verstehen, das Fortpflanzungsgeschehen so effektiv wie möglich zu gestalten, was dann gewährleistet ist, wenn zum Zeitpunkt der ♀♀-Emergenz die ♂♂ schon vollständig geschlüpft und zur Kopula bereit sind. Dies ist ein bei kurzlebigen Tieren wie den Schmetterlingen verbreitetes Phänomen (SCHWERDTFEGER, 1963).
Aus den vorliegenden Ergebnissen ergeben sich zwar Hinweise auf erhöhte Flugaktivitäten solcher proterandrisch auftretender Arten, da die Aussagen über sexuelle Koinzidenz im Untersuchungsgebiet jedoch als unvollständig zu bezeichnen sind, ist ein solcher Zusammenhang noch recht wenig abgesichert.

9.3.6. Bi- und Polyvoltinismus

Unter den bi- und polyvoltinen Arten (siehe 9.2.) ist der Anteil der K-Strategen (23 %) deutlich niedriger als im Gesamtbild, die r-Strategen (32 %) sind überrepräsentiert. Der Wert für die nach 9.3.3. berechnete mittlere Flugdistanz liegt mit 2,6 relativ hoch. Auch SCOTT (1975), GATTER (1981) und MEINEKE (1984) fanden Hinweise darauf, daß mehrbrütige Arten erhöhte Flugaktivitäten zeigen.

9.3.7. Einflüsse der Witterung auf die Mobilität

"Zwischen dem Ablauf der Wetterlage und der Entwicklung der Falterwelt" besteht ein enger Zusammenhang (MICHEL, 1961). Das Anflugverhalten ans Licht ist unter anderem

durch Lufttemperatur, Windstärke und -richtung, Mondphase, Luftfeuchtigkeit und Luftdruck bedingt (KURTZE, 1974; GATTER, 1981; MEINECKE, 1984; u.a.)

- *Günstige Bestandsentwicklungen* aufgrund guter Witterung können indirekt über eine erhöhte Populationsdichte verstärkte Abwanderungen bewirken, wie beispielsweise 1986 bei den Kiefernspezialisten (z.B. *Panolis flammea*).
- *Wind* kann eine mehr oder weniger passive Verfrachtung von Nachtfaltern außerordentlich begünstigen. Im Offenland (HM) traten 1986-1988 biotopfremde Tiere vor allem in Wind-Nächten auf (Tabelle 107).

Tab. 107: Abhängigkeit des Zuflugs biotopfremder Tiere (in % pro Fang) von der Windstärke in der Hauptflugzeit 1986-1988 im Offenland (HM); vergleiche 6.4.4..
Dependence of the influx of off site species (in per cent per capture) of wind intensity during the main flight periods of the years of 1986 to 1988 in open habitats (HM); cf. section 6.4.4..

Wind	Nächte *nights*	aus mindestens 150-300 m Arten (%) *species (%)*	aus mindestens 150-300 m Individuen (%) *individuals (%)*	aus mindestens 800-1000 m Arten (%) *species (%)*	aus mindestens 800-1000 m Individuen (%) *individuals (%)*
windstill *no wind*	30	22	16	4	2
leicht *light wind*	8	27	19	5	3
mittel-böig *moderate wind or gusts*	10	29	20	5	3

Eine Begünstigung von Langstrecken-Dispersal durch Wind, vor allem im offenen Grasland, erwähnen auch SCOTT (1973) und WARNECKE (1952). Für eine Unterstützung von Migrationsflügen durch günstige Winde liegen zahlreiche Hinweise vor (z.B. SCHWERDTFEGER, 1978).

- Bezüglich der *Temperatur* ergaben sich bei den Fremdarten im Offenland keine auffälligen Befunde.

  Ein sprunghaftes Ansteigen der Wiederfang-Wahrscheinlichkeit in bzw. nach kalten Nächten zeigte sich jedoch in vielen Fällen. Die Frühlingsarten im Wasserwerk wurden bereits andiskutiert (8.3.1.). Im Garten (WaS, 1988) zeigte sich bei täglichem Fang in kühleren Nächten fast stets ein höherer Anteil der markierten Falter am Tagesergebnis, z.B. am 4.8. mit 60 und am 20.8. mit 50 Prozent gegenüber Werten, die sonst bei ca. 10-20 % lagen. Beim Spanner *Operophthera brumata* fallen lange Verweilzeiten von ♂♂ über starke Kälteeinbrüche hinweg auf (siehe auch *Meristis trigrammica*, 8.4.2.).

  Die Flugaktivität der Weibchen wird in vielen Fällen durch Kälte besonders stark gehemmt: Lag im Wasserwerk am 2.8.88 (Nachttemperatur durchschnittlich 20 Grad) die ♀♀-Rate von *Scotopteryx chenopodiata* noch bei knapp 50 %, so wurden zwei Tage später (11 Grad) 27 Männchen und kein einziges Weibchen gefangen. Ähnliches wurde beispielsweise auch bei *Ochropleura plecta* und *Xanthorhoe ferrugata* beobachtet. Beim Kälteeinbruch von 19.8. auf den 20.8.88, bei dem die mittleren Nachttemperaturen von ca. 20 Grad auf 13 Grad sanken, war im Garten (WaS) bei den

Weibchen von *Amathes c-nigrum* stark vermehrte Wiederfangereignisse zu registrieren, während die Männchen noch rege am Austauschgeschehen beteiligt waren.

- Bekannt ist die *zerstörerische Wirkung von Unwettern* auf die Nachtfalter. Daher sei hier nur ein Beispiel angeführt: Ende Juli 1988 lagen im Garten (WaS) die Makrolepidopteren-Ausbeuten pro Fang recht konstant bei ca. 200 Individuen, von denen ungefähr die Hälfte markiert wurde; es ereigneten sich jeweils ca. 15 Wiederfänge. Am 24. Juli jedoch war mit 144 Individuen und nur 4 Wiederfängen ein deutlich unterschiedliches Ergebnis festzustellen. Als Erklärung bietet sich das von Sturmböen und Hagel begleitete Unwetter am Nachmittag des 23.7.88 an: Der Hagel führte zu einer erhöhten Mortalität, der Wind zu einem stärkeren Austauschgeschehen. Auf die vorzugsweise an Baumstämmen ruhenden Arten (z.B. "Boarmien") hatte die Witterung dementsprechend weniger Auswirkungen: Sie waren sogar häufiger als tags zuvor.

10. ERGEBNISSE ZUR BIOLOGIE VON NACHTFALTERPOPULATIONEN

10.1. WANDERFALTER

Die Wanderfalter erwiesen sich als "Nullprobe" in den durchgeführten Markierungsexperimenten als hochmobil. Extrem niedrige Wiederfang-Quoten und Verweilzeiten (steil abfallende Verlustkurven) waren zu beobachten (z.B. *Scotia ipsilon, Noctua pronuba, Autographa gamma*).

In vielen Fällen werden besondere "Straßen" benutzt, was im Sinne LATTINs (1967) vermutlich auf Konzentrationseffekten an Hindernissen beruht. Dies war z.B. bei *Autographa gamma* im Dachauer Moos zu beobachten: Schon wenige 100 m von diesen Straßen entfernt (z.B. im Birket, Fangplatz "Mb") ist *A. gamma* (wie auch die anderen Wanderfalterarten) auffallend selten oder fehlt ganz. Wälder werden entsprechend den Beobachtungen GATTERs (1981) bevorzugt um- oder überflogen.

Solche Häufigkeitspeaks, die zwar in gewissem Sinn Barrieren gegen eine freie Verbreitung wiederspiegeln, dürfen daher dennoch nicht vorschnell als Hinweis auf Isolierung von Populationen gewertet werden!

Viele andere hochmobile Arten, die nicht zu den Wanderfaltern gehören (z.B. *Mamestra suasa*) fliegen in den "Wanderfalternächten" an den entsprechenden Stellen in einer auffälligen Weise zusammen mit den migrierenden Arten.

Oft sind hohe Nacht-zu-Nacht-Fluktuationen unabhängig von der Witterung Hinweise auf hohe Mobilität (z.B. bei *Amathes c-nigrum, Amphipyra tragopoginis* oder *Phlogophora meticulosa*), die betreffenden Arten müssen jedoch nicht Wanderfalter sein. Umgekehrt war beispielsweise bei *Jaspidia pygarga* eine sehr hohe Konstanz der Abundanzen festzustellen.

10.2. DIREKTER EINFLUSS VON LICHTQUELLEN

Das Ausmaß einer positiven Antwort auf Lichtreize ist unter anderem art- und geschlechtsspezifisch. Inwieweit auch konditionelle Unterschiede beispielsweise vor und während der Eiablage der ♀♀ eine Rolle spielen, muß hier offenbleiben. Oft reagieren nah verwandte Arten (z.B. *Amathes ditrapezium* und *A. triangulum*) sehr verschieden. Weibchen fliegen Lichtquellen meist weniger stark an als Männchen.

Der direkte Einfluß des Lichts kommt in der Regel erst bei einer Annäherung auf 30-50 m zum Tragen (8.4.). Diese Annäherung muß im Rahmen von trivial movement,

Dispersions- und Migrationsaktivitäten erfolgen. Die hohen Lichtfallen-Individuenausbeuten zeugen also von einem stark dynamischen Geschehen, da es unwahrscheinlich ist, daß sich so viele Individuen in einem so kleinen Radius entwickelt haben.
Die Ergebnisse decken sich mit den Aussagen in PLAUT (1971).

10.3. LEBENSDAUER

Die Wiederfangergebnisse zeigen einen starken Individuenverlust in der ersten Woche, der zum großen Teil auf Abwanderung zurückzuführen ist. Lebensdauern von 5-10 Tagen scheinen die Regel zu sein. Die potentielle Lebenserwartung liegt jedoch meist darüber. Das längste beobachtete Intervall zwischen Erst- und Wiederfang waren 27 Tage bei *Mythimna impura*. Zu ähnlichen Ergebnissen bezüglich der Lebenserwartung (von Tagfaltern) gelangt SCOTT (1973).
Überwinternde Arten leben natürlich um ein Vielfaches länger, einige Spinnerweibchen, die ihren Eivorrat oft sogar noch am Puppenkokon ablegen, dagegen normalerweise nur 1-3 Tage.
Die Ortswiederfang-Quote sinkt bisweilen im Lauf der Flugzeit (z.B. in der 2. Generation von *Chiasmia clathrata*); biotopfremde Arten werden bevorzugt am Flugzeitende registriert (z.B. *Arctia caja*), hier sind oft auch besonders starke Abundanzschwankungen von Nacht zu Nacht bei konstanter Witterung zu beobachten (z.B. *Caradrina morpheus*), was als Hinweis auf dynamisches Geschehen zu werten ist.

10.4. WEIBCHENRATE

Die in Lichtfallen ermittelte Weibchenrate liegt bei den meisten Arten mehr oder weniger deutlich unter 50 %. SCHRIER et al. (1976) und MALICKY (1974 a) gehen trotz eines solchen Befundes von einem natürlichen 1 : 1 - Verhältnis aus. WATT et al. (1977) vermuten bei anderen Tagfalterarten eine höhere Mortalität der Weibchen durch Freßfeinde (z.B. Krabbenspinnen). Demnach spielen der häufigere Bodenkontakt (Eiablage) und die aufgrund der größeren Masse längere Aufwärmphase eine Rolle. Die Dispersionsaktivität wird so hoch veranschlagt wie die der Männchen.
Die Absolutwerte der Weibchenraten stimmen in den meisten Fällen gut mit dem von MALICKY (1974 a) und NOVAK (1974) vorgelegten Zahlenmaterial überein. Dasselbe gilt im wesentlichen bezüglich der sexuellen Koinzidenz für den Vergleich mit den Angaben in NOVAK (1974).
Ein überhöhter Weibchenanteil im Ortswiederfang-Ergebnis (z.B. *Ochropleura plecta*, *Amathes ditrapezium*) kann in bestimmten Fällen als Hinweis auf eine (relativ) erhöhte Mobilität der ♂♂ verstanden werden (vgl. SCOTT, 1973; SCHWERDTFEGER, 1978). Dasselbe gilt für niedrigere ♀♀-Raten an biotopfremden Standorten, z.B. bei *Leucania comma* oder bei den Spannern *Sterrha aversata* und *Scotopteryx chenopodiata*, deren ♀♀ bevorzugt in der Deckung von Gebüschen bleiben.
Es gibt auch Hinweise auf ein umgekehrtes Phänomen: Bei *Scotia clavis*, *S. exclamationis*, *Amathes triangulum* und *A. sexstrigata* scheinen die ♀♀ etwas mobiler zu sein.
Manchmal konzentrieren sich die ♀♀ an besonderen Standorten (z.B. *Hoplodrina alsines*, *Alcis repandata*), bei *Hepialus hecta* scheint die Paarung an bevorzugten Stellen (Waldränder) zu erfolgen. Solche "mating rendezvous sites" kommen nach SCOTT (1973; 1975) bei nordamerikanischen Tagfaltern durch Männchen zustande, die sich an den betreffenden Orten konzentrieren, während die ♀♀ mobiler und mehr oder weniger

gleichmäßig verbreitet sind. Insgesamt betrachtet dürften bei den Nachtfaltern jedoch die Männchen als mobiler zu charakterisieren sein.
Hinweise auf "geschlechtspolarisierte Schwärme" (vgl. SCHWERDTFEGER, 1978) gibt es z.B. bei *Ochropleura plecta*.

10.5. BI- UND POLYVOLTINISMUS

Mehrbrütige Arten sind meist mobiler als einbrütige (9.3.6.). Typische Beispiele hierfür sind *Ochropleura plecta*, *Amathes c-nigrum* und *Mamestra suasa*. Bivoltinismus muß jedoch nicht zwangsläufig hohe Dispersionsaktivität bedeuten (siehe z.B. *Drepana lacertinaria* oder *Cilix glaucata*).
Bei einigen Arten (z.B. *Amathes c-nigrum*, *Cyclophora punctaria*, *Epirrhoe tristata*, *Chiasmia clathrata*) scheint die erste Generation ortstreuer zu sein als die zweite. Biotopfremde Stücke treten dann, wie bei *Chiasmia clathrata*, vor allem in der zweiten Generation auf. Zu ähnlichen Ergebnissen kommen auch LOPEZ et al. (1979).
Der relative Weibchenanteil ist in der zweiten Generation meist höher als in der ersten (z.B. *Ochropleura plecta* oder *Xanthorhoe ferrugata*), was nach MEINEKE (1984) "als Anzeichen verstärkter Dispersions- und Migrationsaktivitäten gedeutet werden" kann.

10.6. ORTSTREUE / HABITATTREUE

Ortstreue und Habitattreue sind zwei nicht identische Phänomene: Deutlich wird dies beispielsweise bei *Pachetra sagittigera*, *Amphipyra pyramidea*, *Cosmia trapezina*, *Cyclophora punctaria*, *Cabera pusaria* oder *Alcis repandata*: Diese durchaus für bestimmte Habitattypen charakteristische Vertreter können nicht als "ortstreu" bezeichnet werden.

Ein Richtungsänderungs-Verhalten an den Habitatgrenzen wurde bei *Chiasmia clathrata* beobachtet, kommt jedoch vermutlich auch bei vielen anderen Arten vor. Hierbei sind Erkennungsmechanismen zu postulieren. Ein solches "Habitatlernen" zur Reduktion der Flug- und Dispersionsaktivität erwähnen SCOTT (1975) und KELLER et al. (1966).

10.7. GELÄNDESTRUKTUREN

Es zeigte sich in einigen Fällen eine Abhängigkeit der Mobilität von der Geländestruktur: In sich geschlossene, gut kompartimentierte Strukturen scheinen die Verweildauern zu steigern (siehe *Calocalpe cervinalis*, *Chiasmia clathrata* und *Ectropis bistortata*).
Unterschiedliche Biotopbeschaffenheiten scheinen auch z.B. bei *Diacrisia sannio*, *Scotia clavis*, *Amathes ditrapezium*, *Rusina ferruginea*, *Meristis trigrammica* und *Operophthera brumata* zu verschiedenartigen Ergebnissen bezüglich der jeweiligen Mobilität geführt zu haben. Außerhalb des typischen Habitats ist diese meist höher.
Langgestreckte Elemente (schmale Wäldchen, lange Waldränder, Waldwege, Hecken) scheinen nicht nur als Leitlinien für hochmobile Arten zu fungieren (siehe Wanderfalter, 10.1., aber auch z.B. *Scotia exclamationis*), sondern auch wichtige Verbreitungshilfen für weniger expansive Arten der Wälder und Waldränder zu sein (siehe z.B. *Xanthorhoe biriviata*, *Calospilos sylvata*, *Alcis repandata*). Für *Calospilos sylvata* stellt vielleicht das Schloßkanalsystem eine solche Struktur dar. Derartige Korridore erwähnen auch WATT et al. (1977). MADER (1980) fordert deren Schaffung im Rahmen einer effektiveren Naturschutzplanung.

10.8. POPULATIONSDICHTE

Erhöhte Dispersionsaktivitäten bei günstigen Bestandsentwicklungen konnten 1986 bei vielen an Kiefern lebenden Arten festgestellt werden (z.B. *Hyloicus pinastri, Panolis flammea, Thera obeliscata* und *Macaria liturata*). Hinweise auf ein solches Phänomen ergaben sich darüber hinaus beispielsweise bei den Arten *Amathes sexstrigata, Tholera decimalis* und *Nonagria typhae*.

10.9. NEKTARQUELLEN

Mobilität zur Deckung des täglichen Energiebedarfs (trivial movement) ist z.B. bei den im Frühjahr fliegenden Arten der Gattung *Orthosia* gut mitzuverfolgen, welche z.T. über größere Strecken hinweg blühende Weiden anfliegen.
Ähnliches mag für viele Waldarten gelten, die einen Ortswechsel an blütenreichere Stellen (Waldwege, vor allem jedoch Waldrand) unternehmen müssen, um zu Nektarquellen zu gelangen.
Gebiete ohne Nektarquellen können Barrieren gegen die Flugaktivität darstellen. Dies muß jedoch nicht unbedingt der Fall sein, wie SCHRIER et al. (1976) anhand der nordamerikanischen Nymphalide *Chlosyne palla* feststellten. Nach WATT et al. (1977) bewirkt ein Ausfall von Nektarressourcen, z.B. durch ungünstige Witterung, nicht dispersionsinduzierend.

10.10. WITTERUNG

Wind kann über zufällige Verdriftungen eine positive Rolle für Verbreitungen der weniger flugaktiven Arten und insbesondere deren ♀♀ spielen (z.B. *Drepana falcataria, Drepana binaria* und *Thera firmata* im Offenland, siehe auch 9.3.7.).
Kälte hemmt dagegen die Flugaktivitäten deutlich (siehe 9.3.7.), insbesondere die der Weibchen. Niederschläge stören das Verbreitungsgeschehen offensichtlich nur, wenn sie besonders heftig sind.

10.11. DISPERSIONSAKTIVITÄT, TRIVIAL MOVEMENT, FLUGDISTANZEN

Nach LATTIN (1967) muß "zwischen einer *potentiellen* und einer *tatsächlichen Vagilität* unterschieden werden". So zeigen sich oft artspezifische Unterschiede, z.B. zwischen *Xanthorhoe designata* und *Nycterosea obstipata*, trotz einer ähnlichen physiologischen Konstitution.
Es wird jedoch aus den vorigen Kapiteln (9.2., 9.3.) ersichtlich, daß sich die Flugaktivitäten der Nachtfalter nicht in feste Schemen pressen lassen, sondern daß sie ein von verschiedenen Faktoren bestimmtes (hoch-)dynamisches Geschehen darstellen. Unter veränderten Bedingungen reagiert auch ein und dieselbe Art oft völlig unterschiedlich. So sind bei manchen Arten trotz einer gewöhnlich hohen Dispersionsaktivität und hohem trivial movement deutliche Barrieren gegen die Verbreitung erkennbar (z.B. bei *Orthosia stabilis*).
Viele Arten schweifen in der weiteren Umgebung mehr oder weniger ungerichtet umher, Hinweise hierfür ergaben sich z.B. bei *Peribatodes rhomboidaria*.
Lokal vorkommende Arten können durchaus einzelne Vorstöße über größere Entfernungen unternehmen. Paradebeispiel ist hierfür der Spanner *Arichanna melanaria*, ein Moorbewohner, für den nicht nur in der vorliegenden Arbeit "Irrflüge" von mindestens 20-30 km nachgewiesen wurden. Ein solches Phänomen kommt bei vielen der sonst weniger expansiven hygrophilen Arten immer wieder einmal vor.

10.12. STRATEGIEN

Das bisweilen kritisierte Konzept des r-K-Kontinuum (z.B. BOYCE, 1984) ist heute ein vielfach angewandter Weg zur Beurteilung von bionomischen Strategien (vergleiche z.B. SOUTHWOOD, 1980; WEIDEMANN, 1986 a; SPITZER & LEPS, 1988).
Typische K-Strategen dürften z.B. *Cirrhia togata, Theria rupicapraria* und *Erannis bajaria* sein. Eine r-Strategie liegt liegt nicht nur bei den bekannten Wanderfaltern, sondern bei einer Vielzahl weiterer Arten vor, darunter auch kleinere Falter wie *Oligia latruncula.*

Oft verfolgen nah verwandte Arten völlig verschiedene Strategien wie z.B. die nur schwierig voneinander unterscheidbaren *Mythimna impura* und *M. pallens.* Ähnliche Paare stellt GLAZIER (1986) gegenüber.
Ubiquisten und Offenlandarten zeichnen sich durch eine größere Expansivität aus als Wald(rand)bewohner und hygrophile Arten (siehe 9.3.3.).

Eine besondere Strategie verfolgen die Arten, die mit ihrer Flugzeit in den Vorfrühling und in den Spätherbst ausgewichen sind (z.B. *Alsophila aescularia, Operophthera brumata*): Der Feinddruck auf die Imagines ist geringer, wodurch es sich die ♀♀ bei vielen Arten leisten können, auf die Ausbildung der Flügel zu "verzichten". Dadurch können höhere Eiproduktionen erreicht werden, eigentlich ein Merkmal der r-Strategen, hier resultieren jedoch Strategien mehr im Bereich des K-Endes des Kontinuums, da bei einer relativ geringen Wahrscheinlichkeit von Totalausfällen der Populationen in einer extremen Nische vergleichsweise stabile Populationsverhältnisse vorliegen (vergleiche REICHHOLF, 1982). Eine derartig starke Spezialisierung ist auch nach SOUTHWOOD (1980) ein auf K-Strategie hinweisendes Indiz.
Interessant ist der Befund, daß relativ fern verwandte Arten miteinander oft durch starke Konvergenzerscheinungen hinsichtlich der Strategie, die sie verfolgen, verbunden sind. Ähnliches berichtet SCOTT (1973) von zwei sympatrisch fliegenden Tagfalterarten.
Bei der Verbreitung von Arten mit flugunfähigen ♀♀ spielen oft Verdriftungen der jungen Raupen durch Wind oder Vögel eine wichtige Rolle (z.B. bei *Orgyia recens*).

Eine Besonderheit stellen auch einige Arten dar, deren Larvalentwicklung sich z.T. über mehrere Jahre erstreckt (z.B. *Cossidae, Cucullia* spec., einige *Apatelinae, Perizoma bifaciata, Pelurga comitata, Eupithecia valerianata, Eupithecia venosata*). Hierdurch wird die potentielle Wachstumsrate der Populationen ("PGR") verringert, die Arten sind tendenziell eher am K-Ende des r-K-Kontinuums anzusiedeln.
Eine assynchrone Larvalentwicklung (z.B. bei *Cossus cossus*) bzw. ein fakultatives Überliegen der Puppen (z.B. bei *Eupithecia venosata*) kann als Puffer ungünstige Bestandsentwicklungen ausgleichen, da jeweils noch Larvalstadien "auf Vorrat" bleiben. Dies kann die für K-Strategen so typische Stabilität der Populationen noch vergrößern. Bei diesen Arten kommt es bisweilen auch zu einem Vortäuschen von Turnover-Ereignissen.

Hinweise auf unterschiedliche Strategien in Abhängigkeit von der geographischen Lage ergaben sich bei *Actinotia hyperici, Earias chlorana* (einhergehend mit einer Veränderung der Generationenzahl) und *Sterrha seriata.*



Abb. 46b: Halbwüchsige Raupe von Orgyia recens. Da die Weibchen dieser Art flugunfähig sind, spielen die Jungraupen für die Verbreitung eine besondere Rolle: Diese wird durch die Möglichkeit eines Verweht-Werdens der langbehaarten Räupchen sowie durch Flugfäden erleichtert.



Abb. 46c: Eupithecia venosata ♀ (ON, 23.6.83); die Puppenruhe erstreckt sich fakultativ über einen bis drei Winter hinweg.

10.13. TRITTSTEIN-KOLONISATIONEN

Einige Arten besiedelten im Verlauf dieses Jahrhunderts das Untersuchungsgebiet vermutlich von den Isarauen (mindestens 7 km) her: *Pelosia muscerda, Gluphisia crenata, Nonagria nexa* und *Chrysoptera c-aureum.*

Im Wasserwerk ereigneten sich recht schnelle Kolonisationen (1-3 Jahre) von hygrophilen Faunenelementen über Distanzen von ca. einem Kilometer (*Mythimna pudorina, Apamea unanimis, Apamea ophiogramma* und *Nonagria typhae*). Ähnliches berichtet auch WARNECKE (1952) von den "Schilfeulen". Naturnah angelegte Tümpel und Teiche (z.B. in Gärten) können auch bei sehr kleinen Flächen wichtige Trittsteinfunktionen erfüllen! Magerrasen-Arten (z.B. *Pachetra sagittigera, Mamestra w-latinum, Leucania comma, Photedes extrema, Eupithecia subumbrata, Eupithecia millefoliata*) hatten die beste Besiedelungsdisposition ausgehend vom Gebiet der Fröttmaninger Heide im Osten (ca. 1 km entfernt), die mit dem vor ca. 10 Jahren neu entstandenen Wasserwerksgelände über Trittsteine in Abständen von 100-300 m vernetzt ist.

In vielen Fällen werden in Gärten Trittsteinsprünge durch eine künstliche Vernetzung von Pflanzen, die von Natur aus lokal vorkommen würden (z.B. *Juniperus*, verschiedene Caryophyllaceen, *Iris, Typha, Clematis* u.s.w.) entschieden begünstigt. Davon profitierende Arten sind z.B. die Nelkeneulen (*Hadena* spec.), *Thera juniperata, Eupithecia intricata, Eupithecia sobrinata* (die letzten drei Arten an Wacholder), *Horisme tersata* (*Clematis*) u.s.w..

10.14. WIRTSPFLANZEN-SPEKTREN

Die Abwesenheit der Raupenfutterpflanzen kann eine bedeutende Barriere gegen die Flugaktivitäten darstellen.

Auch die Strategie der Nachtfalterarten steht in vielen Fällen in enger Beziehung zur Larvalökologie, v.a. zum Wirtspflanzenspektrum: Arten, die auf Pflanzen mit unstetem Auftreten leben, z.B. *Hypena proboscidalis* auf der Brennessel, werden zweckmäßigerweise eine r-Strategie verfolgen. Auf Bäume angewiesene Arten (z.B. ein Großteil der Spanner, *Geometridae*) sind entsprechend der Konstanz ihrer Umwelt nicht so sehr auf Neubesiedelungsprozesse angewiesen und sind oft als K-Strategen zu charakterisieren. Dies entspricht dem Befund, daß sich Ruderalarten als recht mobil herausstellten (9.3.3.). Ihr Lebensraum, der sich in einem frühen Sukzessionsstadium befindet, bietet diesen Arten nicht genügend Stabilität für eine K-Strategie.

Eingeschränktere Wirtspflanzen-Spektren verschieben entsprechend den Ergebnissen von REJMANEK & SPITZER (1982) den Strategietyp oft in Richtung K-Ende des r-K-Kontinuums (z.B. bei den Artenpaaren *Drymonia trimacula/ruficornis, Apoda limacodes/ Heterogenea asella, Mythimna impura/pallens, Ipimorpha retusa/subtusa* und *Oporinia dilutata/autumnata*).

11. ZUSAMMENHÄNGE ZWISCHEN ARTENSPEKTREN-DYNAMIK UND ARTENDYNAMIK

11.1. UNTERSUCHUNGSGEBIET

Wie im ersten Teil der Arbeit deutlich wurde, sind die Parameter Konstanz des Auftretens, Fluktuation (gemessen am Variationskoeffizient) und Turnover stark standortabhängig. Dies erschwert eine genaue Darlegung von Zusammenhängen.

In 6.4.2. und 6.4.3. zeigten sich sowohl für einen österreichischen Standort als auch für das Untersuchungsgebiet sehr niedrige Fluktuationen und Artenumsatz-Raten für die Geometriden-Unterfamilie *Boarmiinae* in ihren typischen Lebensräumen.
Dieser Befund wird durch die Ergebnisse des zweiten Teils besser durchleuchtet: Die Boarmiinen sind vorwiegend als K-Strategen (68 %) einzustufen; der Anteil der r-Strategen liegt hier nur bei 3 %. Der Index der Flugdistanzen (nur 1,8!) verdeutlicht, daß Entfernungen von einem Kilometer außerhalb der normalen Reichweite der meisten Arten liegen. Die im Sinne einer K-Strategie konstanten Populationsverhältnisse schlagen sich also in einer geringen Artenspektren-Dynamik nieder.
Entsprechend sind die Eulenfalter (*Noctuidae*), die stärkeren Abundanzschwankungen und höheren Turnoverraten unterliegen (siehe 6.4.2. und 6.4.3.), vorwiegend r-Strategen (26 %) und intermediär (45 %) bei einem hohen Flugdistanzen-Index von 2,7.

11.2. FLUKTUATION VON EULENFALTERN IN SÜDBÖHMEN

Die von SPITZER & LEPS (1988) vorgelegten Daten stützen sich auf langjährige Beobachtungen von Bestandsentwicklungen dreier Standorte in Südböhmen.
Wenn man einmal den Einfluß der geographischen Entfernung (ca. 200 km) außer Acht läßt, ergeben sich die unten aufgeführten Zusammenhänge mit den Ergebnissen im Untersuchungsgebiet. Hierzu wurden die von SPITZER & LEPS (l.c.) angegebenen Variationskoeffizienten der drei Standorte für jede der Arten gemittelt.

Tab. 108: Zusammenhänge zwischen Strategie (im Untersuchungsgebiet) und Fluktuation (in Südböhmen) bei Eulenfaltern (*Noctuidae*).
Correlation between strategy (in the study area) and fluctuation (in Southern Bohemia) of some noctuid moths.

STRATEGIE *strategy*	K-Strategie	intermediärer Typ	r-Strategie
Mittlerer VARIATIONSKOEFFIZIENT *mean of coefficient of variation*	0,63	0,83	1,03
Getestete Artenzahl n *species number n*	8	26	27

Tab. 109: Zusammenhänge zwischen Flugdistanzen (Gruppen nach SCOTT, 1975; im Untersuchungsgebiet) und Fluktuation (in Südböhmen) bei Eulenfaltern (*Noctuidae*).
Correlation between flight distances (groups after SCOTT, 1975; in the study area) and fluctuation (in Southern Bohemia) of some noctuid moths.

FLUGDISTANZEN *flight distances*	1	1-2	2	2-3	3	3-4	4
Mittlerer VARIATIONSKOEFFIZIENT *mean of coefficient of variation*	-	0,41	0,85	0,90	0,78	0,98	1,14
Getestete Artenzahl n *species number n*	0	1	7	22	14	8	9

Die Tabellen 108 und 109 legen trotz der geographischen Entfernung der beiden Erhebungen deutliche Zusammenhänge offen. Je größer beispielsweise die Distanzen sind, die normalerweise von den betreffenden Arten bewältigt werden, umso instabilere Verhältnisse lassen sich in den Häufigkeitsentwicklungen von Jahr zu Jahr erkennen.
In diesem Sinne stellen EITSCHBERGER & STEINIGER (1973; 1980) neben den typischen Wanderfaltern eine Gruppe von wanderverdächtigen Schmetterlingsarten auf, bei denen häufig starke Populationsschwankungen auftreten.

12. DISKUSSION

Die Flugaktivitäten von Insekten können nach JOHNSON (1969) in zwei Gruppen unterteilt werden: "trivial flights" als Antwort auf die täglichen Bedürfnisse und Dispersions- bzw. Migrationsflüge zur Kolonisation neuer Lebensräume.
Der erste Typ, den man sensu SOUTHWOOD (1967) auch als "trivial movement" bezeichnen kann, dient beispielsweise der Nektaraufnahme, dem Aufsuchen der Geschlechtspartner, dem Eiablagegeschehen oder Fluchtreaktionen. Ihm sind vermutlich die im Rahmen des Versuchs mit den verringerten Fallendistanzen im Wasserwerk festgestellten Austauschprozesse zuzuordnen.
Zum Dispersions- bzw. Migrationsverhalten gehören die nachgewiesenen Kolonisationsvorgänge, das biotopfremde Auftreten vieler Nachtfalter wie im Falle von *Arichanna melanaria*, und die über Strecken von über einen Kilometer geflogenen Exemplare (8.).
Bei den Arten mit flügellosen Weibchen kommt dem Nachtfalterflug (♂♂) verstärkt die Bedeutung einer besseren Gendurchmischung zu, eine Verbreitung mittels Flugaktivitäten ist ja hier nicht möglich.

Verschiedene Strategien konnten sich im Zusammenhang mit Stabilität und Verinselungsgrad der Lebensräume sowie der Stetigkeit der Ressourcen (Raupenfutterpflanzen) entwickeln.
Daher zeigen Standorte in frühen Sukzessionsstadien höhere Artenumsätze und stärkere Häufigkeits-Fluktuationen der Arten als solche im Klimax-Zustand.
Die Offenlandarten entwickelten im Lauf der Evolution relativ große Aktionsräume. Sie konnten sich dies auch leisten, denn die Gefahr eines Sich-Verfliegens ist in den meist großflächigen Lebensräumen vergleichsweise gering. Ausnahmen, z.B. ortstreue Heidebewohner, können nach WARNECKE (1952) dadurch zu erklären sein, daß die betreffenden Arten "in unseren Breiten erst sekundär auf die trockenen und warmen Heiden übergegangen sind, so daß keine inneren Beziehungen zwischen ihrem Flugradius und einem geräumigen Biotop bestehen".

Die im zweiten Teil der Untersuchung festgestellte hohe Dynamik auf dem Artniveau verdeutlicht, daß bei Flächengrößen von 0,2-1 ha - das entspricht größenordnungsmäßig dem Einzugsbereich von Lichtfallen - ständig Extinktions- und Wiederbesiedelungsprozesse stattfinden (siehe 9.3.2.). Diese finden verstärkt (bzw. obligatorisch) bei den r-Strategen statt, welche sich durch die "gut entwickelte Fähigkeit, Standorte wiederzubesiedeln, die durch einen lokalen Zusammenbruch der Population vakant geworden sind" (GLAZIER, 1986), auszeichnen. SCHWERDTFEGER (1978) spricht gar von einem "horror vacui" mancher Populationen.

In Lichtfallen-Artenspektren nachweisbare Turnoverraten spiegeln bei adäquater Methodik real stattfindende Prozesse wieder. Eine besondere Rolle spielen hierbei Kolonisationsversuche standortfremder Arten (siehe 6.2.; 6.4.4.) sowie Austauschereignisse biotoptypischer Arten mit geringen Populationsgrößen.

Die für die Arten charakeristischen normalen Flugdistanzen (9.3.2.) verdeutlichen, daß naturnah gestaltete Lebensräume der verschiedenen Ökotypen mit Abständen von maximal 500 m miteinander vernetzt sein sollten, um effektive Austauschraten zu gewährleisten. Die Isolation zweier Biotope kann nach WATT et al. (1977) ein Mehrfaches der Luftlinie zwischen den beiden Standorten betragen, da ein gerader Flug in vielen Fällen für die Nachtfalter sehr unvorteilhaft wäre. Eine Reduktion des Individuenaustauschs zwischen den Teilpopulationen findet darüber hinaus in kalten Jahren statt (WATT et al., l.c.).

Die Offenlandfauna ist als etwas expansiver zu charakterisieren, die hygrophile benötigt geringere Distanzen für wirksame Trittsteinsprünge; Ausnahmeflüge über große Entfernungen finden jedoch auch hier statt. Diese Befunde stimmen gut mit den Ergebnissen von GERSTBERGER & STIESY (1987) überein.

Die dortigen Aussagen zu Flächen-Mindestgrößen decken sich ebenfalls mit vielen der im Untersuchungsgebiet gemachten Beobachtungen. Demnach genügen der xerothermophilen Schmetterlingsfauna schon Gebiete von ca. 3 ha (= ungefähr die Größe des Wasserwerksgeländes). Viele nässeliebende Arten besiedeln selbst große Flächen ("75 ha") nicht, wenn die Gebiete verinselt sind (GERSTBERGER & STIESY, l.c.; HEYDEMANN, 1980). Dagegen können für manche Arten (z.B. *Nonagria typhae*) Kleinstgewässer wichtige Trittsteinfunktionen übernehmen (siehe 10.13.).

Die Ergebnisse zur Ausbreitungsökologie der Nachtfalter unterstreichen die Forderung MADERs (1980) nach einer Raumordnungs-Konzeption, in der großflächige Schutzgebiete ("200 km^2") durch Trittsteine vernetzt und über Korridore verbunden sind.
Die Angabe von "Minimalarealen" sollte *zu schaffende* Flächen betreffen. "Wegen der fortschreitenden Parzellierung ... erübrigt es sich, untere Schwellenwerte *noch zu duldender* Restflächen zu benennen" (MADER, 1980).

ZUSAMMENFASSUNG

Das Gemeindegebiet Oberschleißheim (31 km^2) im Münchener Norden war in den Jahren 1987/1988 Objekt einer Untersuchung von Nachtfalter-Artenspektren und -Flugaktivitäten.
In der Methode des Lebend-Lichtfallenfangs wurde hierzu ein Fangstellennetz von 10 Standorten pro Jahr (insgesamt 15 Standorte) betrieben. Es wurde jeweils parallel mit mehreren Fallen gleichzeitig gefangen, so daß sich eine Summe von 1438 Fängen ergibt. Die 49.072 Makroheteroceren-Individuen waren 462 Arten zuzuordnen. Zusammen mit Tagbeobachtungen und Meldungen aus anderen Jahren ergeben sich 514 Nachtfalterarten für das Untersuchungsgebiet.

Die Artenspektren eines definierten Lichtfallen-Einzugsbereiches zeigen von Jahr zu Jahr einen Artenumsatz (Turnover) von größenordnungsmäßig 35-55 %. Dieser Turnover ist standortspezifisch, abhängig vom Sukzessionsstadium des Biotops und abhängig von der gerade betrachteten Artengruppe.

Zugeflogene biotopfremde "Gastarten" sind am Austauschgeschehen deutlich stärker beteiligt als andere Arten, was als Hinweis darauf zu werten ist, daß der apparente Artenumsatz real in der Natur stattfindende Prozesse wiederspiegelt und nicht nur einen Artefakt, bedingt durch methodische Unschärfe in der Artenerfassung, darstellt.
Bei zunehmender Flächengröße verringert sich der Turnover durch die Pufferwirkung der größeren Habitatdiversität beträchtlich.

Bezüglich der Zusammenhänge zwischen Turnover, Konstanz des Auftretens und Häufigkeitsfluktuationen ergibt sich in der vorliegenden Untersuchung ein ähnliches Bild wie bei den Tagfaltern am unteren Inn (REICHHOLF, 1986) und bei Nachtfaltern im Gitschtal (WIESER, 1987):
Die Konstanz des Auftretens verteilt sich nicht gleichmäßig, sondern es überwiegen die ganz regelmäßig sowie die sehr unregelmäßig auftretenden Arten. Konstanz und Fluktuation sind streng negativ miteinander korreliert. Bei der Betrachtung verschiedener Artengruppen zeigt sich auch eine positive Korrelation zwischen Fluktuation und Turnoverrate.
Im Offenland zeigte sich, daß sich unter den konstant auftretenden Arten ein Großteil aus bodenständigen Arten rekrutiert, während die Mehrzahl der wenig regelmäßig erscheinenden Arten zugeflogen ist.

Eine Abschätzung der Abhängigkeit der Artenzahl vom Fangrhythmus ergab, daß in einem Einzeljahr offensichtlich tatsächlich Arten abwesend sind, und daß sich Artenspektren aufgrund von Turnoverereignissen erst im Lauf mehrerer Jahre vervollständigen.
Eine weitere Abschätzung der Zahl der unter der Erfassungsschwelle gebliebenen Arten mit Hilfe der von PRESTON (1948) angenommenen Normalverteilung von Häufigkeitsstrukturen ergibt ähnliche Hinweise.

In einigen durchgeführten Experimenten wurden 23.818 Individuen aus 131 Arten markiert; es ereigneten sich 1347 Wiederfänge, davon 13 über Entfernungen von mindestens einem Kilometer (11 Noctuiden und 2 relativ flugkräftige Geometriden; nur ♂♂).

Bei einer Verringerung der Fallendistanzen auf 50-120 m erhöht sich die Wiederfang-Wahrscheinlichkeit durch die Miterfassung von Individuen, die in der näheren Umgebung herumvagabundieren. Eine Auflistung der Arten nach Wiederfang-Quoten und mittleren Verweildauern ergibt zwei Gradienten. die sich in etwa entsprechen. Die Wanderfalter zeigen erwartungsgemäß die jeweils niedrigsten Werte. Die Verteilungen dürften in etwa dem r-K-Kontinuum der Populationsbiologie entsprechen.

Bei künstlich in Entfernungen von 30-120 m Entfernung versetzten Nachtfaltern ergaben sich verschiedene artespezifische Muster: Hochmobile Arten zeigten einen starken Abfall der Wiederfang-Wahrscheinlichkeit schon bei 30-60 m; fast alle Wiederfänge ereignen sich hier nach einer Nacht; ähnliches berichtet PLAUT (1971). Von weniger flugaktiven Arten erhält man aus Entfernungen von 90-120 m vergleichsweise viele Individuen zurück (auch nach mehreren Tagen), was auf einem Herumvagabundieren der Falter in der Umgebung beruht.
Durch ein artspezifisches Ausmaß der direkten Lichtanziehung kommt es bei kontinuierlichem Lebend-Lichtfallenbetrieb zu Häufigkeitsverzerrungen. Eine fangfreie Nacht genügt zu einer ausreichenden Durchmischung der Bestände.

Rückschlüsse aus Ortswiederfängen an einem Einzelstandort können zu sehr verfälschten Ergebnissen führen, in Verbindung mit den durchgeführten Experimenten als Interpretationshilfen können sie jedoch einen guten informativen Wert zur Beurteilung von Flugaktivitäten erlangen.

Eine Charakteristik aller nachgewiesenen Arten hinsichtlich ihrer Flugdistanzen und der erkennbaren Verbreitungsstrategien offenbart eine Dynamik auf hohem Niveau: 98 % des Artenspektrums sind als Arten gekennzeichnet, bei denen das Abfliegen aus dem Einzugsbereich der Lichtfalle heraus ein normaler Vorgang ist.
Ubiquisten und Offenlandarten einschließlich der xerothermophilen Fauna sind als expansiver einzustufen als Wald(rand)- und Gebüscharten sowie die hygrophile Fauna. Ruderalarten fallen entsprechend der Instabilität der Ressourcen durch große Flugdistanzen und präferenzielle r-Strategie auf.
Auch mehrbrütige Arten sind bevorzugt r-Strategen und liegen mit ihren Dispersionsaktivitäten über dem Durchschnitt. Die zweite Generation ist hierbei meist expansiver.
Kälte hemmt, Wind fördert bisweilen das Verbreitungsgeschehen. Geländestrukturen, Populationsdichte und Verfügbarkeit von Nektarquellen stellen weitere die Flugaktivität determinierende Faktoren dar.

Die Verbreitungsstrategien der Nachtfalter sind artspezifisch, oft verhalten sich die Populationen nah verwandter Arten völlig unterschiedlich, während sich Konvergenzerscheinungen relativ fern miteinander verwandter Arten erkennen lassen.
Die Möglichkeit zu Trittsteinsprüngen spielt bei der Verbreitung eine entscheidende Rolle. In Gärten wird diese durch eine künstliche Vernetzung von Pflanzen, die von Natur aus nur lokal vorkommen würden, entschieden begünstigt.
Die Strategie steht in vielen Fällen in enger Beziehung zu den Raupenfutterpflanzen: Instabilität der Ressourcen und breit gefächerte Wirtspflanzenspektren sind oft mit einer r-Strategie verbunden.

Es zeigte sich, daß K-Strategen sowie Arten mit geringen Dispersionsaktivitäten in Lichtfallen-Artenspektren tendenziell durch niedrigere Turnoverraten und Fluktuationen auffallen. Diese stabilen Populationsverhältnisse entsprechen der Definition ihrer Strategie.

Eine Vernetzung von Biotopen sollte - nach den vorliegenden Ergebnissen beurteilt - in Distanzen von maximal 500 m erfolgen; dieser Wert ist jedoch je nach Biotoptyp differenziert zu verstehen.

DANK
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ANHANG: SUMMARY

Species spectrum of moths and their flight activities were investigated 1987/1988 in the village of Oberschleißheim (31 km^2) in the northern periphery of Munich.
For this aim, a net of 10 light-traps per year with a total of 15 locations was operated. Parallel catches took place with several traps at the same time. The results were 1438 catches. A total of 49.072 individuals and 462 species (*Macroheterocera*) could be ascertained. Together with earlier and later recordings and observations in the daytime 514 species of moths could be recorded in the study area.

The species spectra of a definite sphere of influence covered by one light-trap reveals a year-to-year turnover of about 35-55%. These changes in the species composition are specific for location and taxon and depend also on the successional stage of the habitat.

The occurence of species changes is prominently biased towards immigrated "guest-species" that are foreign in this habitat. The other species show lower turnover rates. This fact indicates, that the apparent turnover reflects real processes occuring in nature and not a methodical error due to problems with the precision of the method for recording species.
Turnover decreases with increasing size of the area covered by the traps. This can be explained by the greater habitat diversity and thus by the presence of more refugial localities.

As far as the relations concerned that exist between turnover, constancy of occurrence and abundance fluctuations, the results of the present paper show a very similar pattern to the butterflies in eastern Bavaria (REICHHOLF, 1986) and the moths in southeastern Austria (WIESER, 1987):
The constancy distributions do not show an equal level for every class: the main part of the species was occuring with a very high or a very low degree of constancy. Constancy and abundance fluctuations are strongly negatively correlated. With regard to the various systematic groups there was found a positive correlation between fluctuations and turnover rate.
In the open grassland a great part of the species occuring every or almost every year are to characterize as propagating in site, while the main part of the low-constancy species are origin off site.

An estimation of the dependence of the species number on the rhythm of catches shows, that in a single year some species are absent indeed and that species spectra complete themselves in the run of several years due to changes in the species composition.
A further estimation of the number of species, that are too rare for having been recorded, uses the log-normal abundance distribution postulated by PRESTON (1948). The results are quite similar.

In some experiments there were 23.818 specimens marked, belonging to 131 species; of the total of 1347 recaptures, 13 took place over distances of at least one kilometre (11 Noctuidae and 2 quite robust Geometridae; only males).

When distances between traps are chosen a little bit closer (50-120 m), the probability of recapture increases by also catching specimens vagabonding in the wider periphery of the other traps. When species are plotted according to their recapture rates and their average residence times, these lists show two gradients, that are quite similar to each other. The migratory species are to find (how it was to expect) on the lower end of the lists: These distributions seem to correspond to the r-K-continuum of the population biology.

When moths are transfered in distances of 30-120 m, there result some species-specific patterns: Species with a high dispersal show a significant decrease of recapture probability already at 30-60 m; nearly all of the recaptures occured after one night; similar results are to be found in PLAUT (1971). When species with lower flight acti-

vity are tested, from distances of 90-120 m there are recaptured comparably many individuals (also after intervals of some days). This fact can be explained by a "vagabonding" of the moths in the wider periphery of the traps.
The species specific degree of effective attraction of moths by the light source causes an overestimate of relative abundances when the trap is operated continuously. A night without catch is sufficient to guarantee the specimens to mix up with the rest of the populations on a high level.
Interpretations which base on the probability of recaptures at the same site can lead to very false results. Together with the experiments made in this study they can gain a high informative value in the discussion of flight activities.

A characterization of all the species recorded in this study considering the potential flight distances and their bionomic strategies, reveals dynamics on a high level: 98% of the species spectrum are characterized as species, for those it seems to be a usual act to fly out of the sphere of influence of the light-trap.
Ubiquists, species of the open grassland and xerothermophilic species are more expansive than the species typical for woods, shrub-formations and the hygrophilic fauna. Ruderal species developed (according to the instability of their resources) preferably a r-strategy combined with great flight distances.
Also the polyvoltine species are mainly r-strategists, their dispersals are situated on a higher level than the average of the other species is. The second generation is in nearly all of the cases more expansive than the first. Cold weather handicaps, wind sometimes favour dispersal. Topography, population density and presence of specific nectar sources are further factors determining flight activities.

The bionomic strategies of moths are species specific. Often the reaction of populations of species closely related to each other are quite different, while there are cases of convergence to be found investigating comparably unrelated species.
The possibility of jumps using "little habitat islands" is a very important factor for processes of colonisation over greater distances. In gardens this is favoured very much by an artificial network of many different food plant species that occur in nature with a more local distribution.
The strategy is in many cases strongly correlated with the larval food plants: Instability of the resources and high degree of polyphagy often coincide with r-strategy.

K-strategists and species with low dispersal show up in species spectra of light-traps with tendentiously lower turnover rates and lower abundance fluctuations. These population dynamics on a low level correspond to the definition of their strategy.

In accordance with the results of this study the linking of habitats should occur in distances of not more than 500 m; this value has to be modified according to the habitat type.

Bisher erschienene Supplementbände der Spixiana

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